THE INSTITUTION OF PRODUCTION ENGINEERS JOURNAL

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PRODUCTION ENGINEERS JOURNAL

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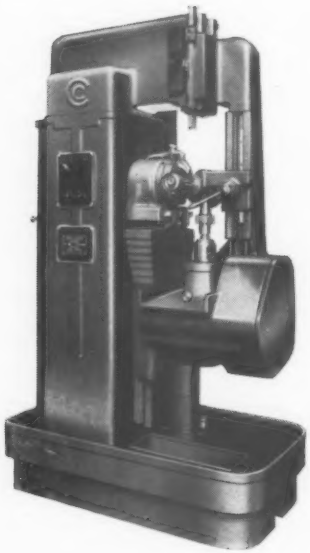

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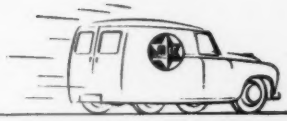

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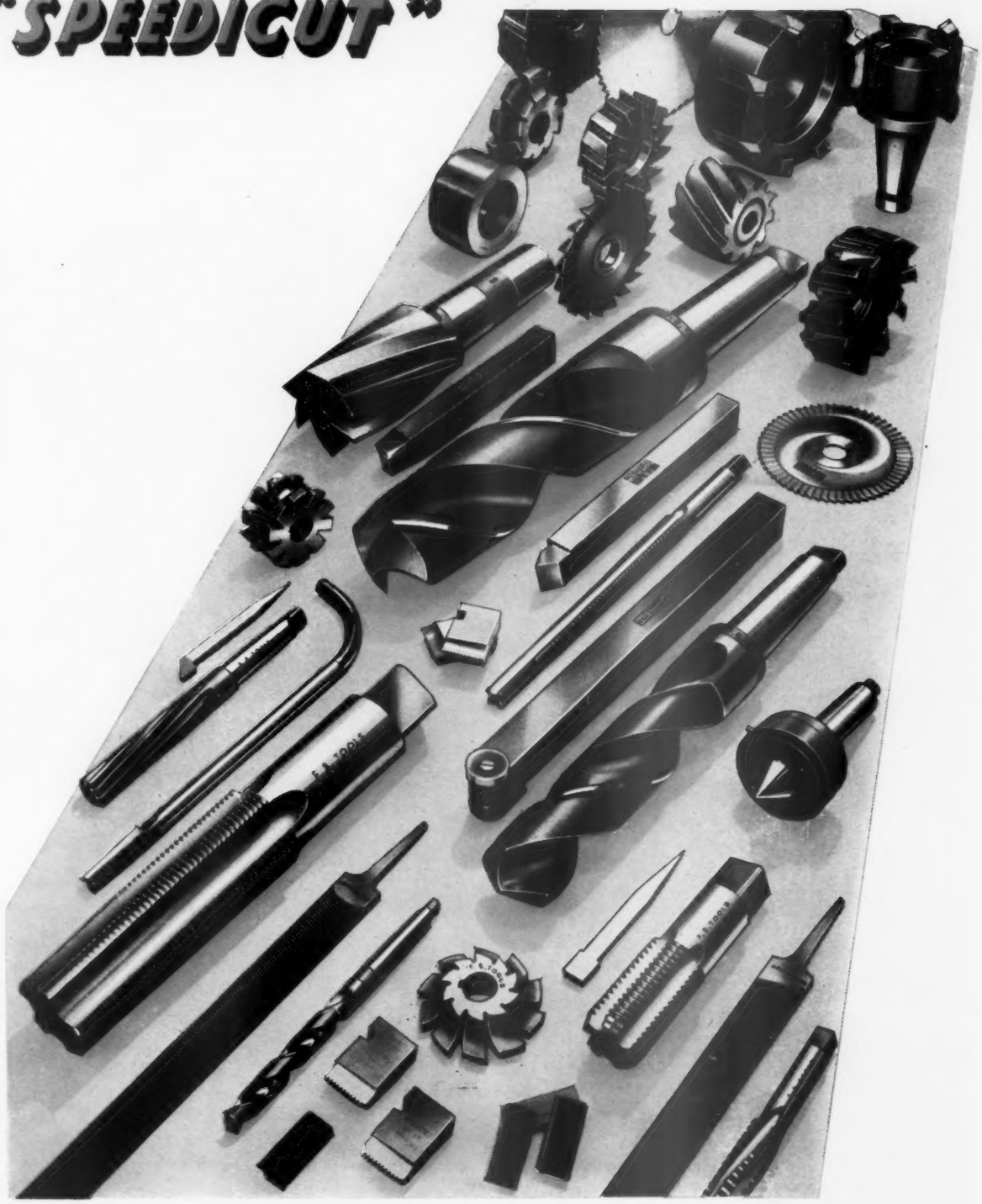

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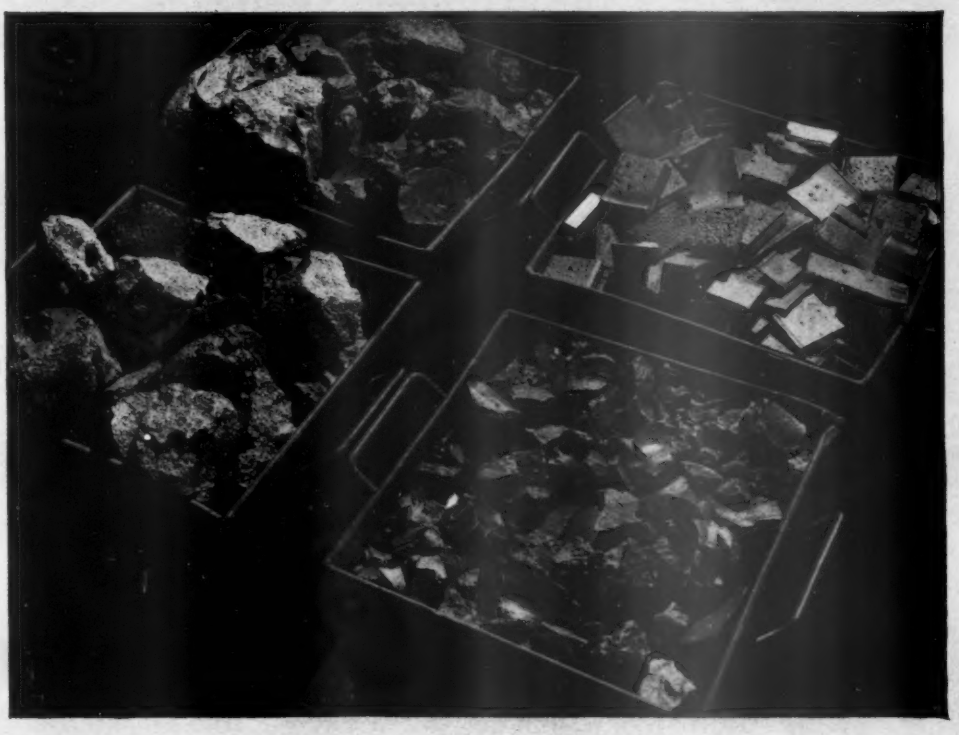

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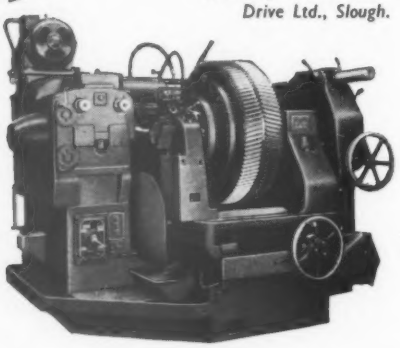

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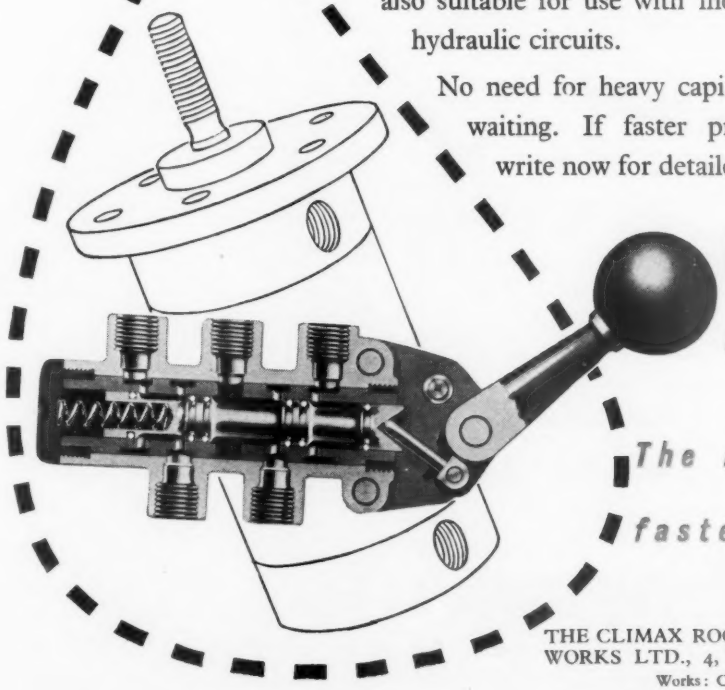

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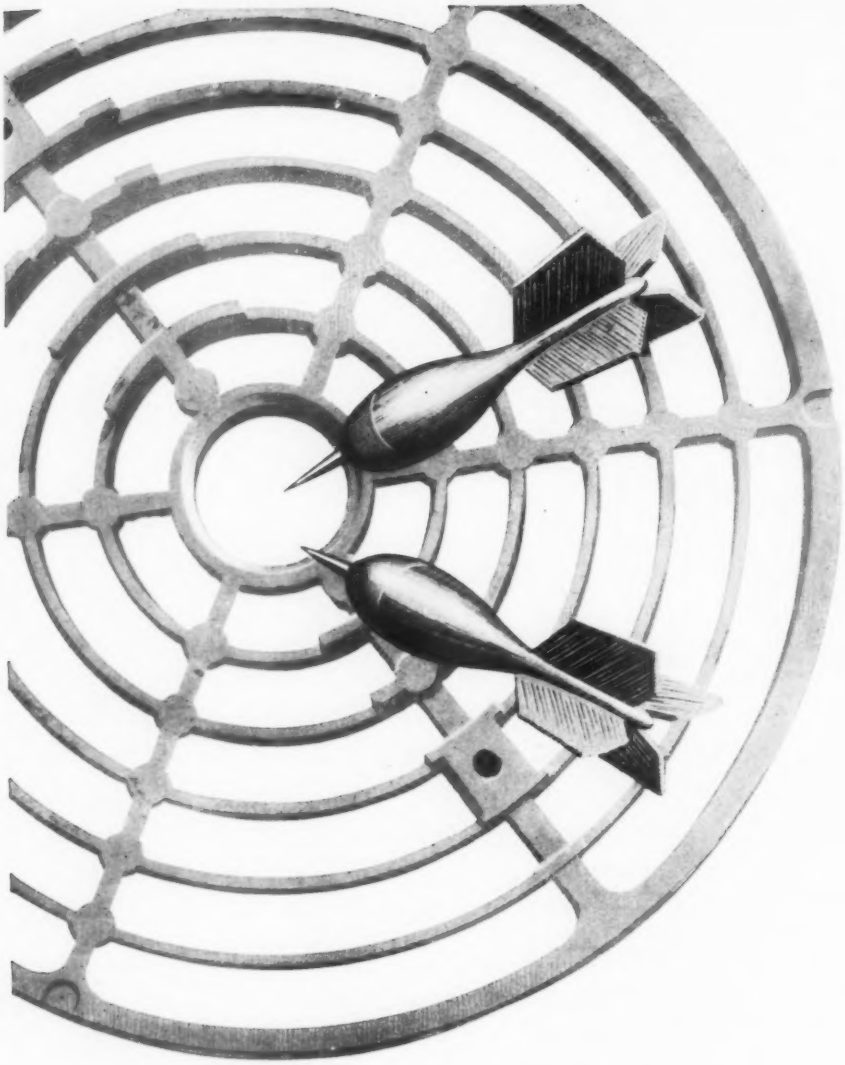

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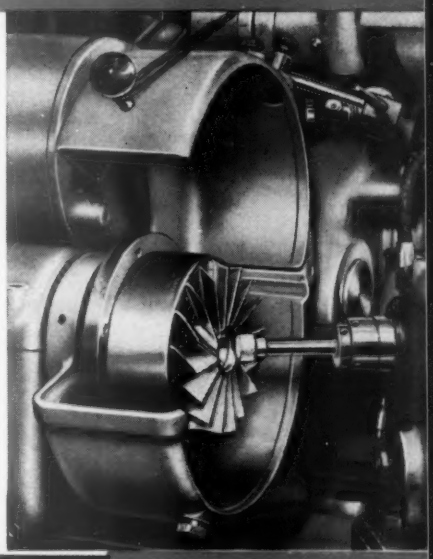

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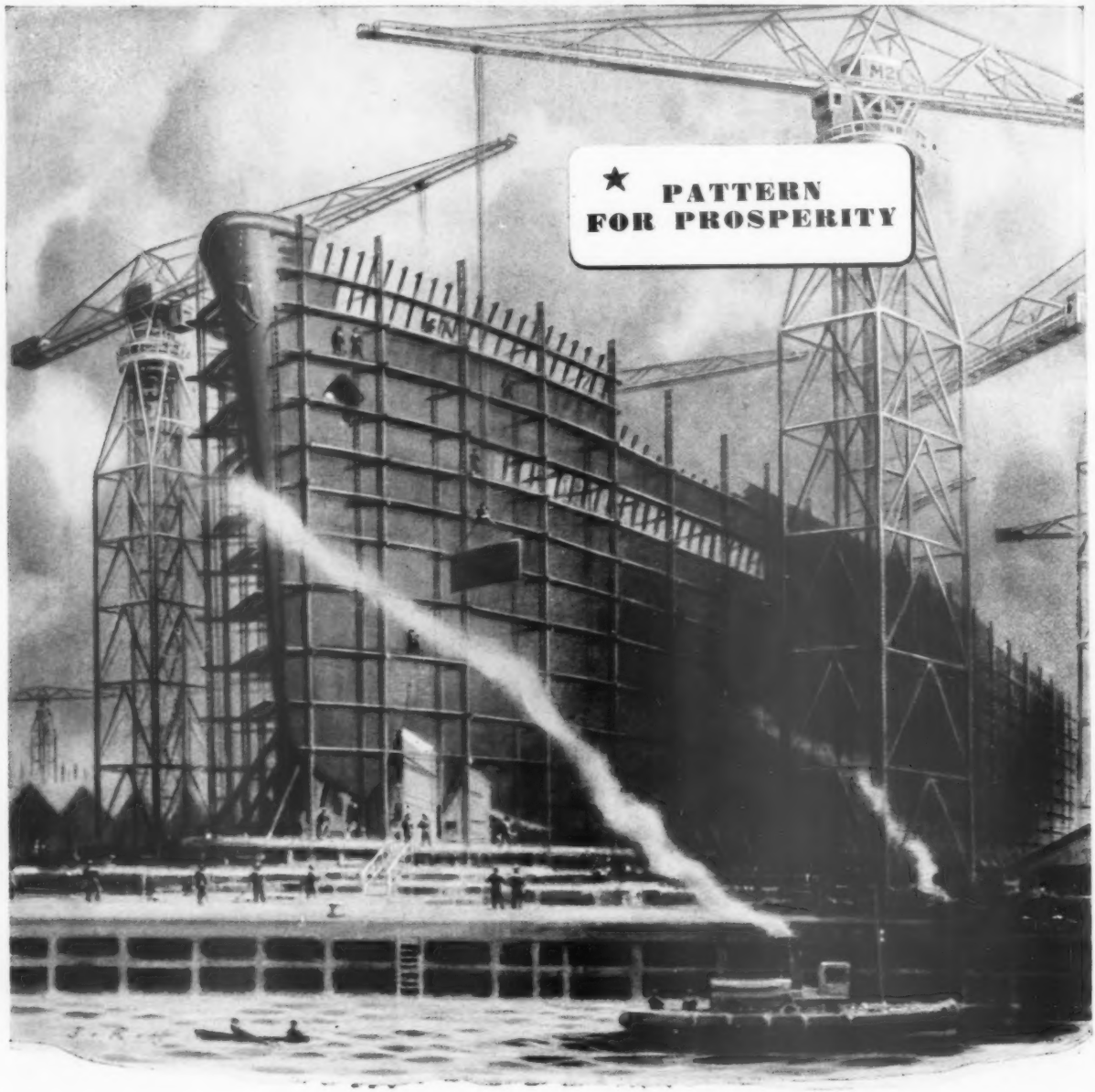

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The Institution of Production Engineers Journal
VOL. 32. NO. 8 AUGUST, 1953

In place of the usual leading article, the Institution publishes two of the addresses given at the Conference Banquet, Harrogate, on 25th June, 1953.

"The Institution"

by The Right Hon. The Viscount Swinton, P.C., G.B.E., C.H., M.C.,
Secretary of State for Commonwealth Relations.

IT is both a pleasure and a privilege to propose the health of this Institution. From what I have read and what I see you are in good health and good heart. You grow larger and larger. You have, I understand, almost reaches the 10,000 mark, but you do not believe that safety rests merely in numbers; you believe, as I know from your work, that quality is as important as quantity, and you inculcate that in all your training. You take your people young but, like the Commonwealth, you do not admit them into full partnership until you are satisfied that they are fully qualified; and young and old —no, I must not say "old", so let me say young and in the prime of life—all are learning all the time, learning at home and also, as I see from your report, learning abroad, and through the Institution pooling their knowledge.

I am very glad that you have extended your activities to the Commonwealth.

Nothing is more important today than production. I am so glad that you do not call it "productivity". This frightful jargon, which has come from I do not know where, should find no place in any respectable circles. Everything turns on production, whether in the factory or on the farm. We are, of course, in some ways a most artificial and a most vulnerable community. We import, even when we have stepped up our agricultural production, half of what we eat; and from what I have seen tonight, as well as from the statistical returns supplied to me, we seem to be eating more and with a better choice. We import—except for coal, which I hope is going to be produced in larger quantities—nearly all our raw materia!.

We have to pay for all this by what we sell, our goods and services. We used to have great overseas investments, which were very useful, but they have all gone west—or most of them have— in two World Wars. Before the last War started, the world owed every man, woman and child in this country £80 per head. Today, every man, woman and child in this country owes the rest of the world between £50 and £55. I think that is a more graphic way of putting it than to talk in terms of thousands of millions of pounds.

The sellers' market has gone for good and today in the markets of the world the buyer is king. Everywhere there is increasing competition. Some markets are closed by quotas and restrictions of various kinds. In many parts of the world the whole ordinary pattern of trade has changed, and we can only live if we give our customers what they want at prices which they are prepared to pay.

I was looking, as I drove here this evening, at the programme of your Conference. If I may say so, I find that you are extraordinary practical and up-to-date in what you propose to study and, oddly enough, some of the things which you are going to discuss tomorrow and the day after are things on which I had already thought of offering you a few elementary observations this evening.

I am going to deal with all the liabilities first—I do not like balance sheets which conceal or slur over the liabilities. We have a formidable task, but it is not beyond our strength if we face the facts and deal with them in the right spirit. On the other side of the balance sheet we have really tremendous assets, if we use them aright. It is no good keeping assets or talents in napkins; you come to a sticky finish, as the Good Book tells us, if you do.

The Nation's Assets

On the assets side we have first of all our people—a great people, a very great people, resilient, resolute, with scientific invention second to none. We have a world-wide reputation for quality, and a unique experience in finance, merchanting, shipping, insurance, and the like. In all these matters we

have that "know-how" which is so important, and for which people are prepared to pay. That is one of our great assets which we did not have to expend when we stood alone in defence of a free world. We have not only that "know-how," but something more which goes with it, and that is integrity, a reputation for integrity for a hundred years or more, a reputation for our word being our bond; and with that there goes world-wide good will.

I am certainly not going to try to teach you your business. You Production Engineers have a vital part to play, and technically you are doing it, and you will go on doing it, and doing it better and better if, as I know you are, you are all convinced—even the youngest of you!—that you do not know everything before you start. So you go on learning all the time and go on pooling your knowledge. I would rather leave with you two or three more general thoughts which I believe should permeate all our individual efforts.

We have all a part to play, but we have to play it in a team, and we cannot exaggerate the importance of team work in every sphere. There must be a working partnership between design and production. My memory goes back—and there are some in this room whom I have met again tonight whose memories will go back with mine—to the days when we tried to build an Air Force from nothing and we did, after all, manage to build an Air Force which won the Battle of Britain. I remember, coming entirely new to this problem—I had been in other business, but not aircraft—the individualism of firms, and sometimes the individualism of men who were great geniuses. There was one man who was, I felt certain, a genius, and I staked my faith in that to the tune of a good many millions of pounds of the taxpayer's money. He was a genius, but he believed, as some great scientific and artistic designers do, that he was the high priest of a mystery which was only to be celebrated in the most holy secrecy, whereas really, as I ventured to say to him, what he ought to be doing was working and living and sleeping with the whole of the production team. I am afraid that I was perhaps more tough than tactful in what I said. He was surprised, but he did not resent it, and after going at it for about an hour and a half, hammer and tongs, it ended very well. He became one of the greatest designers in the world—he had had it in him then to be so—and never from that moment onwards was there any complaint. He lived with the production managers, and the next time I saw him he said: "The damned production manager will not do this"—and then I knew that everything was all right! The country owes this man an immense debt.

There must be this partnership between research and production. We must have research, both long-range and short-range. We must never ignore the need for long-range research, and firms are quite right to spend a great deal of money on it, but at the same time the board must control research just as it runs production. There must be short-range research as well.

Production and Salesmanship

You must also link up your production with salesmanship, and you can help the salesman by giving him a good production story to tell. He can tell you how to meet market needs and not only how to meet the needs of today, but how to look forward to and anticipate the tastes and requirements of your customers tomorrow.

There must be team work amongst all those engaged in actual production but, as I see it, this team work, this combined effort, must go far outside the individual business. It ought to permeate the whole of an industry. It is paradoxically but absolutely true that competition and collaboration can go very well together. That is obviously true of research, and you cannot have a better example of that than the magnificent research establishment of the wool industry in Leeds, where you have almost every firm in the industry, big and small, working together, and where I was delighted to find the production people going in to see what the research people were doing.

This combined effort must be on an even wider basis. I have spoken of our great assets in finance, merchanting, banking and so on. All these are needed and must form part of a combined effort and must be mobilised as part of the team. That is the first thought which I should give you.

"Know-how" is, of course, very important, but what is perhaps more important is that everybody concerned should know enough. Most people in this room will have served in one of the Services, and may remember that in one of the Service handbooks—I think in *Infantry Training*—it is said that every officer and man should have sufficient knowledge of the general idea to carry out his particular operation. That is really good sense, and it is just as important in business as it is in the Services. It is most important that the facts of economic life should be fully understood by the workers in every factory, and first of all the fundamental truth of how we live and pay our way.

I was thinking of how I would put this, and then I read a speech made by Mr. Cooper at the Congress of the National Union of General and Municipal Workers. I should like to read you what he said, because it is worth-while quoting: "One fact which emerges clearly," he said, "from a critical examination of the nation's economic situation is that our survival as a trading nation and as a political power in the world is in peril." He was talking to an audience representing the whole of the membership of

the second largest trade union in this country, and he went on: "We must produce goods both for home consumption and for export in sufficient volume and at prices which will allow us to compete in world markets. Some 30 per cent. of our working population are working for export. If we were to lose only one-tenth of our export trade, the effect would be not only to put out of work nearly 750,000 people directly affected by the loss, but also hundreds of thousands more engaged in providing goods and services for the home market."

I have never heard it put better or more concisely than that. Sometimes I do not understand economists, but I have come to the conclusion that some of the best economists are to be found in the ranks of the trade union movement.

We shall only bring home these general truths, however, if we relate the general to the particular. It is not easy. There is a long legacy of suspicion, as well as a great deal of false doctrine. The faults have not been on one side only. It is not surprising, when some firms have not tried to break the suspicion down by giving their people the facts; they say that their people do not want to hear them. I still occasionally, but only very occasionally, hear it said: "Why do you want to tell the workmen that sort of thing? It does not interest them." I hear that from a man who does not really know the facts of his own business. The larger the business and the more specialised and the more routine in character a man's job, the harder it is for him to relate what he is doing to the overall problem and the general need, but it is of the utmost importance that he should do so.

Telling the Workers the Facts

What can we do about it? I should like the workers in every firm to know the difficulties that the firm are up against in foreign markets, what the firm is doing to meet them, where it succeeds and where it fails. When a contract is secured, tell the workers how keen the competition was to get it, what were the prices quoted by foreign competitors, how prices have had to be cut to get the contract, what has had to be done about delivery dates, which are often, as you know, more important even than prices in getting a contract, and may be decisive as to whether a contract is won or lost. When a contract has been lost, tell the workers why the firm has lost it. I would also tell them all that is being done in salesmanship. They will work harder if they believe that all those in the team are doing their best. You cannot ask a man to work harder unless he knows the result of what he is doing and that everybody is playing a part.

I have spoken of the salesmanship side of this story, and this is another way in which salesmanship links up with this problem. Let the people in your factory know how you are selling and, as simply and as graphically as possible, try to show them what you are doing to sell your goods and what your competitors are doing.

I know that a great many firms today are doing this, and are doing it effectively. I know the difficulties, but I know I am right about this. I know that it meets resistance, like sales resistance—resistance from people who do not want to bother about it, even on the workers' side. There may even be opposition by people who do not want production to succeed. You must, however, continue to work at it. We are all in this together and unless we all do our best to make these facts known in our workshops, we shall be falling down on our own job and not pulling our weight in the team.

Importance of Unity and Co-operation

I have spoken of the importance of unity and understanding and co-operation in industry. I should like to end on an equally important but much larger unity, the Commonwealth and Empire. It is thirty-three years since I attended my first of what we used to call in those days Imperial Conferences. In the last eighteen months we have had three. The first was a Conference of Finance Ministers which we called together as soon as we could after we came into power, when the reserves were vanishing like the snow in spring. Last December we had a Conference for which the Prime Ministers came over, and we have just finished our third one, when the Prime Ministers met again.

In all those three I have been enormously impressed by the common interest and outlook and the unity of purpose displayed. At the first, when the Finance Ministers met, we were under the compelling need, individually and collectively, to improve our reserves, to stop the drain on them and to increase our trade. Last December I was nervous about the Conference. The Prime Ministers could come only for a very short time, and we were going to do a tremendous lot in a fortnight, whereas the Conferences which I had attended before had taken two or three times as long. However, that Conference succeeded completely, and it succeeded because of the preparatory work which had been done in advance. That has an application for you, because the pooling of knowledge and experience in advance enabled us all to start with a common datum of knowledge. In the last one, held only this month, we covered the whole field of world affairs, and on the last day took the economic side in our stride. We were meeting under the inspiration of the Coronation, and all that it meant.

Here over a wide field it would have been very easy to disagree, and we are all completely independent. The mystery of the independence and unity of the Commonwealth defies the comprehension

of nearly everybody who does not happen to belong to it, but is quite obvious to all of us. It could have been quite different. I sensed at the beginning the feeling of unity, and as we got down to more and more detail, instead of getting less that sense of unity and common purpose increased, as you will have seen from the communiqué which we issued at the end. I can say with absolute confidence that the unity of the Commonwealth is as real as ever it was, and it is indeed good for the free world that it should be so, because the need was never greater. A united Commonwealth has a tremendous part to play within the Commonwealth, in partnership with America and also in co-operation with Europe, where your President is doing such an admirable job today. It is a part which no other group or unit can play, but to play that part we must be united and strong, strong in defence and strong economically, because economic strength is the basis of all military strength. Above all, we must be strong in spirit and firm in the right, as God gives us to see the right.

Lord Swinton then called on the assembly to rise and drink the health of the Institution.

"The Guests"

Response by SIR CHARLES MORRIS, M.A., Ll.D.,

Vice-Chancellor of the University of Leeds.

YOU have been good enough to invite me as a guest and to allow me to speak for the guests, but I cannot conceal from you that I come from the university world. I do not know what you think about the universities, and that puts me in a difficult position.

You are interested in production—Lord Swinton has told us not to speak of "productivity!" They tell me in my University that the rate of productivity in the United States is still going up twice as fast as the rate of productivity here. I dare say that "productivity" does not mean very much, but my experience is that most people who go to the United States come back and tell the same sort of story, or at any rate they come back feeling the same emotions.

You are interested in production, and I, as you know from my record, am interested in the young. Several speakers, and notably Mr. Puckey, have already said something about the young and have told us that we should bear in mind that the young are absolutely priceless material. I suppose that most of us in the university world, or at any rate a good many of us, are there because of our great interest in research of one kind or another, and because the country is willing to put at our disposal very valuable equipment and opportunities to get on with research, and I think that the opportunities are being taken. At least I understand from such travels as I have made that it is pretty widely recognised round the world—and I think Lord Swinton said something of the same kind—that in the field of pure science and pure scientific inventiveness we are, to say the least of it, second to no country in the world. When you consider our scientific man-power in relation to the size of our population, it is saying a great deal to say that we are second to none in the world, and the universities must have a little of the credit for that.

But, while many of my colleagues and friends are in the university world because of the opportunity that the country is willing to give them for research, by and large most of us would not be there if we were not passionately interested in the young. We are interested in the young because we *are* interested in the young, but also because we think that the future of the world and of this country depends enormously on the right use of the young. We have to bear in mind that we do not direct the young into the paths in which they should go. If we think that they ought to be engineers, we do not direct them into engineering; if we think that they should go into the Church, we do not direct them into the Church; if we think that they ought to go into research in physics, we do not direct them to do so. We have to have some machinery by which we can make pretty sure that the very able young—and here I do not speak merely of narrow intellectual gifts, but of those who are able in other directions as well, those with great force of character or with great capacity for producing a harmony between their temperaments and abilities in order to do great work in their lives—will, of their own accord, discover that it is the best thing that they can do to fit themselves into the right niche and do the right job.

You as Production Engineers, I know—and I should have known it even without the speeches which we have heard this evening—are interested in what happens to the young and where they go. I know that some of you sometimes say that still too many of the young study arts subjects. Some of you sometimes say that still too many of the able young study the pure science subjects, and so on. Nothing

could be truer than that it matters enormously to us that the abilities and the qualities of the young should be used in the right places, but we must get them right.

Clearly we must not do anything to risk our position in the world of pure scientific man-power. Equally, we cannot afford not to use a very high proportion of the ability and temperament and character of the young in the engineering field, and of course especially in the production engineering field.

I want to leave you with this thought. The methods by which it is decided whether the young, at the age of seventeen or eighteen, shall go to the universities or not, have been revolutionised since the war. The methods are not perfect. Even if they were perfect, even if we had perfected the techniques by which we try to choose all the able people to go to the universities and colleges, the Americans tell us that a good number of people would still be left outside. The fact remains, however, that a very large number of very able young men who would twenty years ago not have gone to college or university but to the workshop and the office, and who through industry would have been taken into management and into technical jobs through training in industry, are now going to full-time three-year and four-year courses in colleges and universities, and unless when they come out they go back into industry, industry will be that much the poorer, in spite of the most prodigious efforts which you may make to try to do without them.

You may turn to me and say that the universities make the young interested in other things. British universities have acquired a reputation for interesting people in politics, in the Church, in administration, in the law, in journalism, and of course in the Empire. You will say "If these people do not come back into industry, whose fault is that?" But it does depend on you as much as on us. We have to do a very great deal to see that the young do, according to their abilities, their insight, their inventiveness and their character, what God intended them to do. Without your help in industry, and without very close contact between you and the universities, it cannot be done. We do not tell people what to do. We show them that there is great work to be done in certain fields, that they have precisely the qualities which are needed in those fields, and that they will be given opportunities in those fields. Unless we get together, we shall fail on that.

INSTITUTION ANNUAL DINNER

9th OCTOBER, 1953

The Institution has been honoured this year by being granted permission by the Corporation of the City of London to hold the Annual Dinner in the Guildhall.

The Guests of Honour will be Sir Rupert De la Bère, Lord Mayor of London, and The Right Hon. Viscount Waverley, P.C., G.B.E., G.C.S.I., G.C.I.E., Ll.D., F.R.S. Lord Waverley will be well-known to members as Sir John Anderson, distinguished scientist and statesman. He was created a Viscount in 1952.

Members are advised to make early application for Dinner Tickets to the Secretary of the Institution, using the form included in the Supplement to this issue of the Journal.

THE INDUSTRIAL APPLICATIONS OF RADIOACTIVE MATERIALS

by SIR JOHN COCKCROFT, K.C.B., C.B.E., M.I.E.E., F.R.S.
Director, Atomic Energy Research Establishment, Harwell.

Presented to the Institution in Oxford, 24th July, 1953.

The Characteristics of Radioactive Elements

The properties of the elements are determined by the constitution of their central nuclei — by the number of the fundamental bricks — neutrons and protons — from which they are made up. The first figure shows the nuclear constitution of a few stable elements. An ordinary hydrogen nucleus contains one proton; the rare heavy hydrogen contains one proton and two neutrons. This turns out to be an unstable combination—so a tritium nucleus in the course of time will change a neutron into a proton. Thus, by acquiring two positive charges, it turns into helium. But in the course of changing a neutron into a proton, electrical charge has to be conserved so an energetic electron is created and ejected.

This is a general characteristic of radioactive forms of the elements. They have been created, either by Nature, or by Man with too many protons or too many neutrons. Sooner or later they remedy this fault of their creation by changing one form of brick into another. The observing physicist sees this by a high speed electron being ejected and in many cases a penetrating electromagnetic ray, a gamma ray, is sent out also to signal the occurrence of the event.

The radioactive elements have therefore two distinguishing characters. First of all, the average time they exist before changing their nucleus varies greatly—we specify this by a so-called half life—the time during which half the nuclei will change over; second, by the characteristics of the radiations they emit in the process. The half lives of radioactive elements range from micro seconds to millions of years. The radiations, whether of electron or gamma rays, are specified by giving their energy in electron volts. Thus, radio cobalt, which is much used in radiography, has a half life of about 5 years and gives out gamma rays of a little over 1 million electron volts energy. The energy of the radiation determines its penetrating power and the cobalt radiation will penetrate in a useful way 2 to 6 inches of steel.

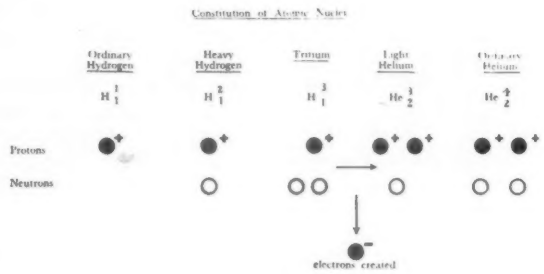


Fig. 1 Constitution of nucleus

Sir John Cockcroft

The Creation of Radioactive Elements

Radioactive elements were created in a wide variety in the initial creation process of our Universe, about 3 billion years ago.

Since that time most of the short lived elements have returned to stability leaving, however, a few important radioactive elements particularly amongst the heavy elements. The best known amongst these are uranium and radium, but there remain altogether 16 of the radio elements created by Nature. Radium has a half life of 1,600 years and gives rise to a chain of unstable daughter products, some of which—such as radon—are useful to industry. The first application of radioactive elements to industry came therefore from the use of radium and its decay products.

Most of the radio elements available to industry are now made in an atomic pile. Figures 2 and 3 show

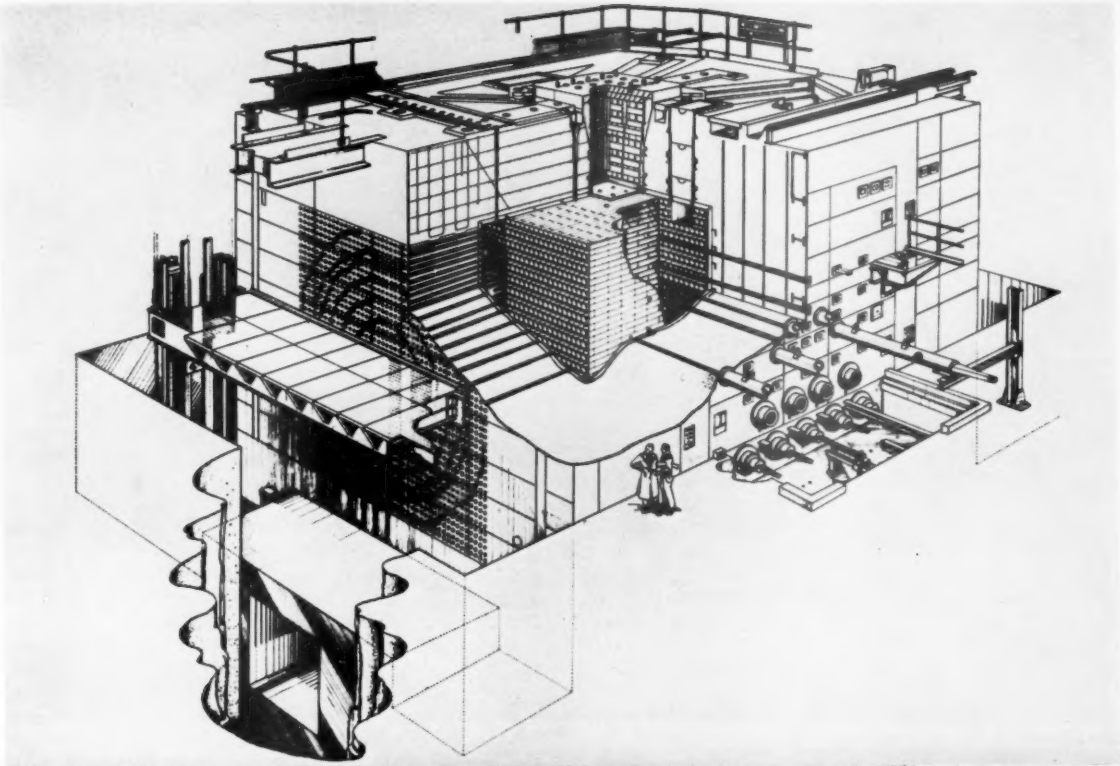


Fig. 2 (top) B.E.P.O. interior

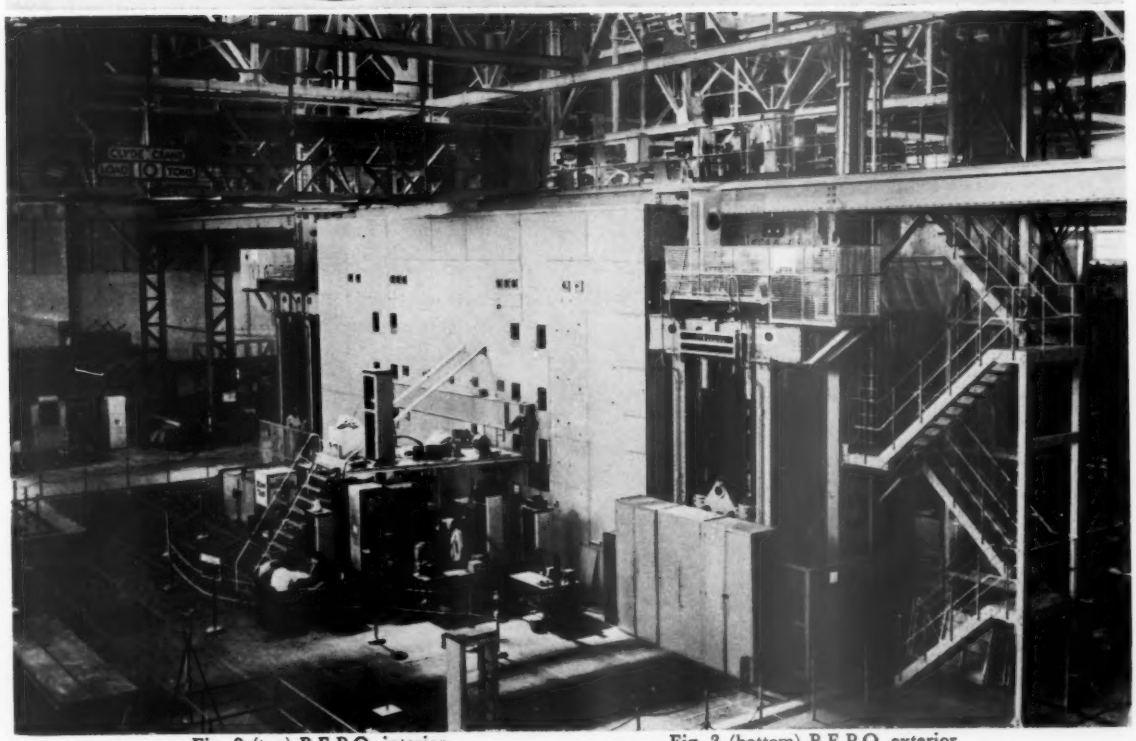


Fig. 3 (bottom) B.E.P.O. exterior

the interior construction and the exterior of the Harwell pile, which is now a principal source of creation of these elements. The pile consists of a pile of very pure graphite blocks between which are spaced 20,000 bars of uranium metal, clad in aluminium. The uranium nuclei split up at a controlled rate and throw out neutrons which split up more uranium nuclei in a so-called chain reaction. Heat equivalent to about 6,000 kilowatts is developed in the uranium metal bars; powerful gamma rays are emitted and neutrons fly about in all directions at high speeds. The uranium nuclei split up into two fragments which are usually radioactive. So amongst the waste products of the pile—the so-called fission products—we have at least 30 kinds of radioactive elements.

For the most part, however, we use the neutrons flying about in the pile to create new elements. The neutron enters a nucleus and thereby increases the number of neutrons by one. This new nucleus will often be unstable and so a radioactive element has been created. For example, if we put cobalt wire or rod in the pile, a cobalt nucleus of atomic weight 59 turns to cobalt 60, which emits the penetrating gamma rays I have spoken about.

So, each Monday morning we load into the B.E.P.O. a large number of aluminium cans containing materials which are to be transformed into radioactive elements. Figures 4 and 5 illustrate this. They will remain in the pile for varying periods. The elements of long half life such as cobalt stay a long time, because the radioactivity builds up steadily for a period comparable with their half life. Short lived

Fig. 4 Graphite stringers and holes

elements will stay in for periods of a week or so and Monday morning sees a great activity in discharging these elements. Figures 6 and 7 illustrate this.

Radiography

The industrial applications of radioactive elements are now in an interesting growing stage. The oldest application is to radiography since radon, the gaseous daughter of radium, has long been and is still used for this purpose. The penetrating γ-rays from the radioactive products are used to take photographs similar to X-ray pictures, to show up deficencies in castings, forgings, welds and assembled products. The radioactive elements provide a wide range of radiations which can be chosen to suit the job. At one end of the energy scale the radiations from Thulium 170,

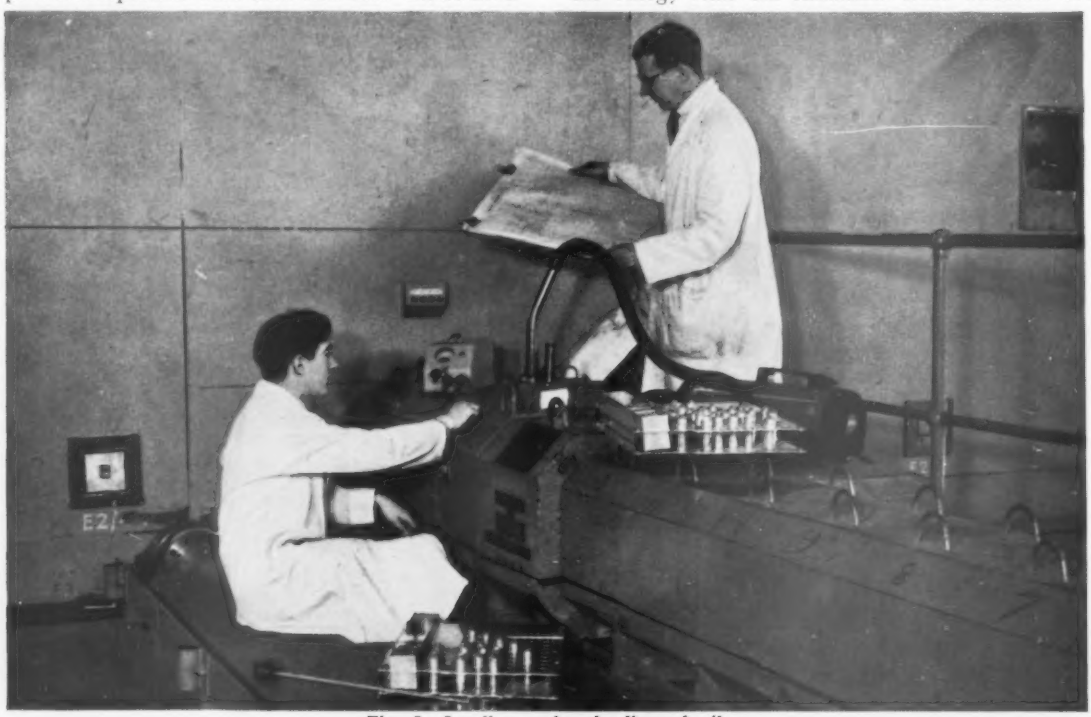


Fig. 5 Loading and unloading of pile

Fig. 6 Removal of isotopes

which have the modest energy of 85 kilovolts, are very suitable for radiography of light alloys since great penetration is not required and good contrast is obtained. This is evidenced by Figure 8 which shows a radiograph of a radio valve and stop watch. Radio iridium (192) emits gamma rays of 600 kilovolts maximum energy and is useful for thicknesses of steel between ½ inch and 2 inches. It can be obtained in very strong sources and is used widely for testing of welded boiler plates and steam pipes. A typical technique is to insert the small source on the axis of a pipe and to wrap a flexible cassette of film around a peripheral weld. A 15-minute exposure will then reveal the whole weld in a picture that can be shown to the welder. Figures 9 and 10 show typical arrangements. When I was in New Zealand I visited a new hydro-electric station and was interested to find that faulty welds in some of the Penstocks were being radiographed on the site by the use of radio iridium sources flown out in 7 days from Harwell. Figures 11 and 12 show typical sources and a radiograph of a faulty weld. The radio iridium has the advantage of high intensity for a given price, but loses half its activity in 70 days and has to be returned to the pile to be reactivated.

Radio cobalt has a longer half life of 5.3 years and emits gamma rays of 1,200 kilovolts energy. It is therefore useful for steel thicknesses of up to 6 inches. Figure 13 illustrates a panoramic exposure arrangement, whereby many castings from a single source can be radiographed.

Fig. 7 Packing container for isotopes

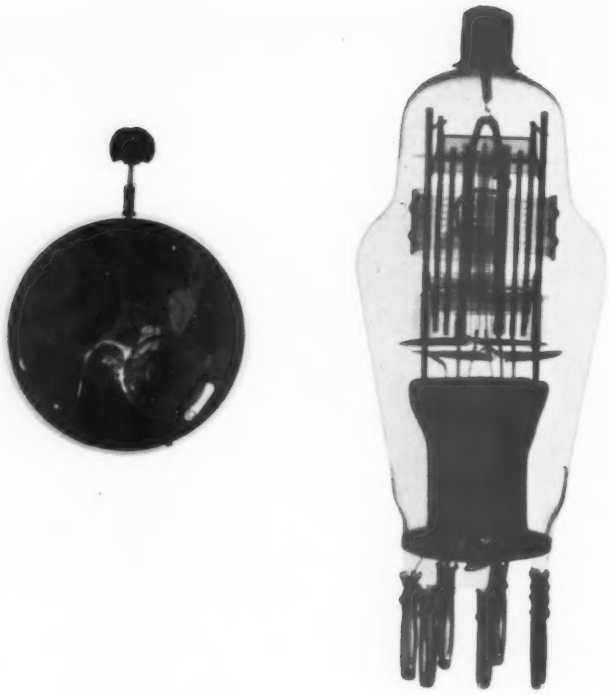


Fig. 8 Radiograph of Stop Watch and Radio Valve

Radiography can also be used to check the assembly of mechanism inside opaque cases. Figure 14 shows a radiograph of a telephone receiver.

Radioactive elements can also be used to show up fine surface cracks in metals. An experiment was carried out for The de Havilland Aircraft Co., who wished to search for fine cracks in propeller metal. So a solution of radio phosphorus—which emits electrons—was made in a detergent in order to reduce the surface tension. The solution thus spread uniformly over the surface. After removing the surplus a photographic film was put in contact with the metal surface. Since the radio phosphorus solution had penetrated the cracks, the film was blackened in the position of the cracks. This is the method of radio autography.

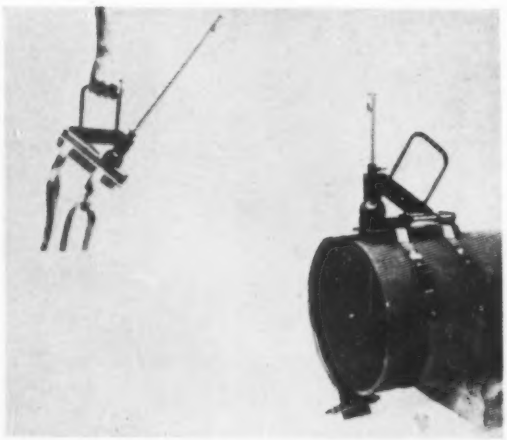


Fig. 9(a) Method of radiograph of welds

Use of Radiation to determine Strip Thicknesses and Package Filling

The number of electrons transmitted by materials depends on the thickness of the material, its density and the energy of the electron. We can therefore measure continuously the thickness of strip as it comes from the rolling mill, by placing a radioactive source emitting electrons on one side of the strip and a meter to measure the electron intensity on the other. Figure 15 illustrates the principle. Gauges of this kind are in use commercially for the measurement and continuous thickness control of steel, brass, copper, cardboard, plastic film, paper. Thallium 204 is used for materials having weight up to about 120 milligrams/sq. cm. Strontium 90 emits more penetrating electrons and is used up to four times greater density of material—up to 1/16″ aluminium, for example. For still heavier materials, gamma rays from iridium can be used.

This same property of radiation can be used to act as a control on package filling. Thus it is possible to detect that a single tablet is missing in a packet of aspirin (Fig. 17).

Fig. 9 (b)
Method of radiograph
of welds

Radioactive gauges can also be built to measure the thickness of plating, such as tin plating. The electrons from a radioactive source are scattered backwards into a counter, mainly by the tin layer which is heavier than the substrate. By such a device the thickness of the tin plate can be measured with an accuracy of 1/100,000 inch. This obviously enables great control and economy of material to be obtained (Fig. 16).

This same method of back scattering can be applied to measure the wall thickness of steel tubes having diameters of 2 inches upwards and a wall thickness of 0.1″ to 1″. Quite small sources can be used and measurements of wall thicknesses can be made with an accuracy of 3 to 4 per cent. This enables the corrosion of tubes to be followed.

There is a possibility that coal can be separated from shale by taking advantage of the different scattering of gamma rays. Thus, in a preliminary test it was found that the radiation from Thulium was back scattered about 25 per cent. more from coal than from shale. A belt conveyor would carry the coal plus shale and an ejector would get rid of the shale automatically.

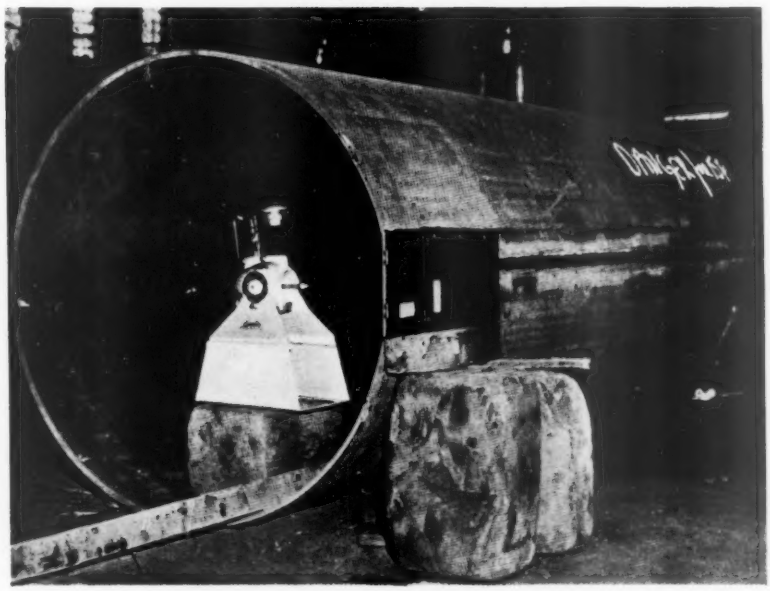


Fig. 10 Boiler weld tests

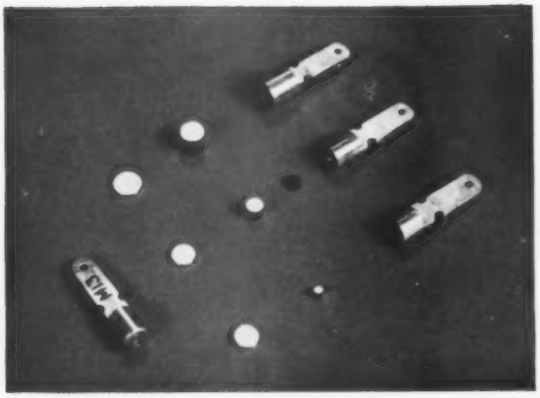


Fig. 11 Radioactive sources

Applications of the Ionising Properties of Radiation

When high speed electrons pass through gases they displace electrons from the atoms of the gas, and leave it in a so-called ionised state which conducts electricity, since the displaced electrons can move freely in an electric field (Figs. 18 and 19).

This property can be used industrially to conduct away troublesome electric charges. This happens, for example, in the weaving of some fabrics such as nylon. The fabric collects electric charges and thus attracts dirt and produces marks. If the air is made conducting by a radioactive source, the electric charge leaks away and marking is prevented. Static eliminators have been developed by the Shirley Institute, using Radio Thallium or Radium Strontium incorporated into a silver foil. Figure 20 shows the results achieved.

This property of ionising gases is also useful in helping cold cathode valves to become conducting at a consistent voltage. So a little radioactive hydrogen is introduced into the valve and then taken out again, but leaving enough behind on the walls to throw out sufficient electrons to produce the requisite amount of ionisation.

Process Control

Radioactive materials can be used for a wide variety of process controls, by making use of the extremely sensitive methods available for their detection—methods which can detect as little as 10^{-12} grams. In one interesting example, a cattle food manufacturer was adding a very small trace of a vitamin to a large amount of cattle food and it was difficult to establish if his mixing process was adequate enough. So a small amount of radioactive sodium chloride was added to the vitamin before mixing. The food was then added to a conveyor belt, where a counter indicated the activity and showed directly whether the mixing was uniform. Figure 21 illustrates this.

The Chemical Engineering Division at Harwell have used radioactive tracers to control separation processes. Hafnium and Zirconium occur together in Nature and have to be separated to produce Zirconium metal suitable for atomic piles. This can be done in an ion exchange column. A little radioactive Zirconium and Hafnium is added to the material to be separated. The two materials are first adsorbed on the ion exchange resin until the resin is saturated. At this stage, radioactivity begins to appear at the bottom of the column. A washing out agent for one material is added and it is possible by measuring the radioactivity to measure how much of it is removed. When the greater part of this constitution has been washed out, the second washing

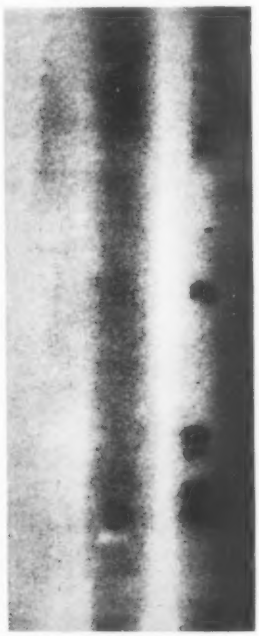


Fig. 12 Faulty weld

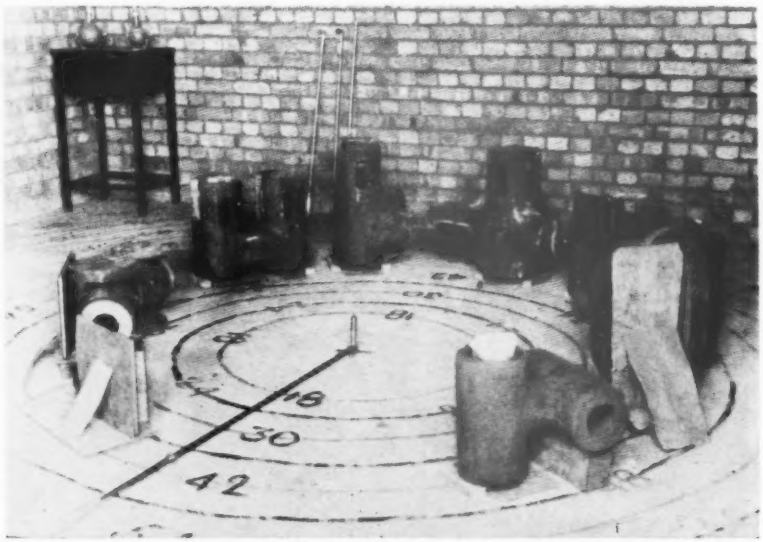


Fig. 13 Panoramic exposure

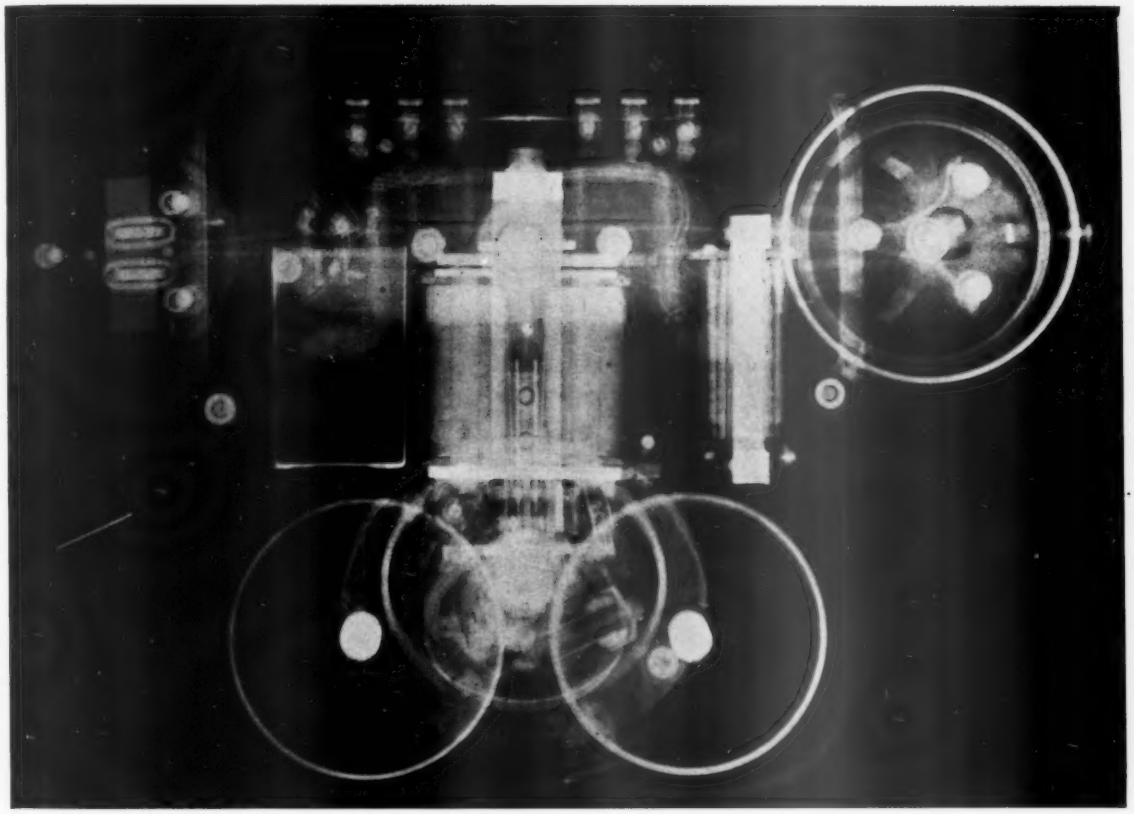


Fig. 14 Radiograph of a telephone receiver

out agent is added and so the second material is separated.

Leakage and Penetration Testing

The ease with which small amounts of material can be detected by their radioactivity makes it possible to use radioactive tracers as leak detectors. Radio Sodium is dissolved as sodium carbonate in water at quite low levels of activity and inserted into a leaking water main. Measurements are then made of ground water samples with a radiation counter. It proved to be possible to detect leaks as small as one pint per hour.

Leaks in underground cells can also be detected by radioactivity. In France, a number of long distance telephone cables contain paper-insulated wires in a jute-covered lead envelope under 0.8 atmospheres of nitrogen. Any hole in the lead envelope would be

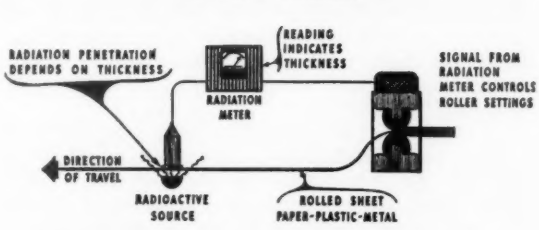


Fig. 15 Thickness gauge

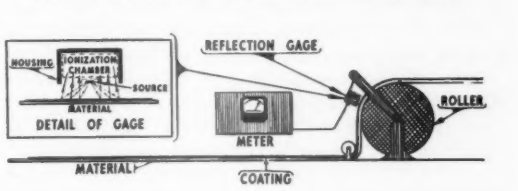


Fig. 16 Back scattering gauge

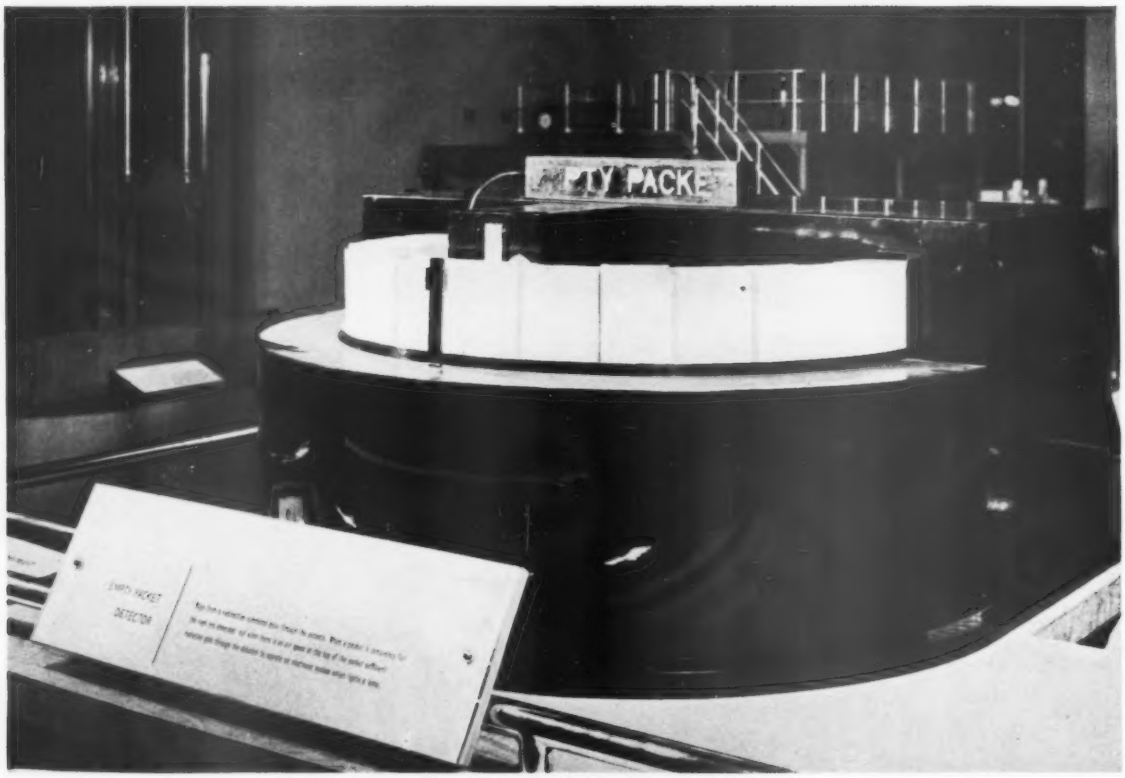


Fig. 17 Package filling detector

disastrous if not detected and repaired before water has time to leak in. The approximate position of the leak can be found by pressure fall methods. A radioactive gas, methyl bromide with radiobromine, is then injected. The leakage can then be detected by instruments carried above ground by a man walking at a brisk pace (Fig. 22).

Use of Radioactive Sources as Markers

It is often necessary to determine the position of objects in underground borings or pipe lines. Thus a 50-mile pipe line in Scotland had to be cleared before admitting oil. This was done by a scraper—"Go Devil". If it got stuck it would be very difficult to locate the exact position, so a small source of radio cobalt was attached, which could easily show up the position (Fig. 23).

Fig. 18 Discharge of static

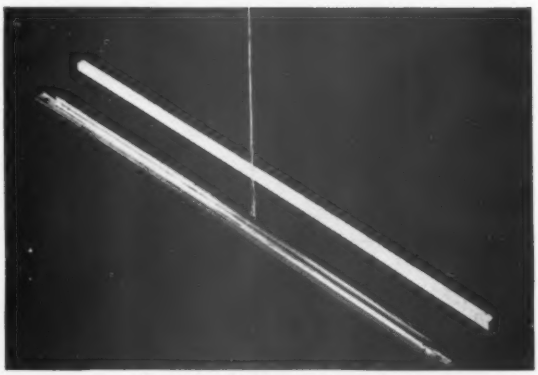


Fig. 19 Discharge of static

In drilling vertical and horizontal bore holes for underground gasification work, it was desirable to measure the miss distance of the two bores. So a radio cobalt source was put in one bore and a radiation meter in the other, enabling the miss distance to be measured with an accuracy of a few inches.

In a similar way, the arrival of the interface between two batches of oil in a pipe-line can be determined exactly, so that the new batch of oil can be diverted to a separate tank (Fig. 24).

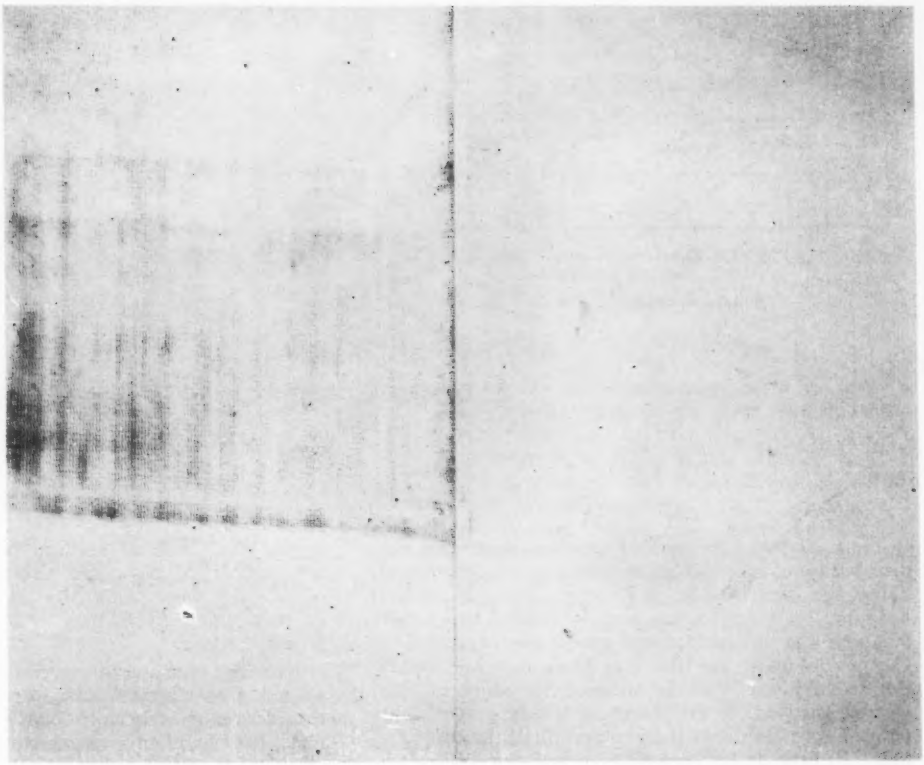


Fig. 20 Fog marking

Application of Radioactive Materials to Chemical Engineering

In addition to these proved applications of radioactive materials to industry, new and larger scale applications are beginning to appear on the horizon, with the coming advent of much larger radioactive sources.

The applications I have described so far have required radioactive sources having an activity at the most equivalent to that of a gram of radium.

We can now produce radio cobalt or radio iridium sources having an activity 1,000 times higher—we call this a 1,000 curie source. We can also envisage within 2 or 3 years extracting from radioactive waste products, sources of radio caesium 100,000 times greater than one gram of radium.

We are at present using a 300 curie Radio cobalt source at Harwell to study the effect of radiation on chemical reactions. In these reactions gaseous products, such as ethylene, are transformed by high temperature and pressure in the presence of a catalyst into a polymer, such as polythene. Now it turns out that these reactions will take place in the presence of radiation without the high temperature. This might result in production economies.

Radiations can also change the properties of the polymer by producing more cross linkages in the molecule.

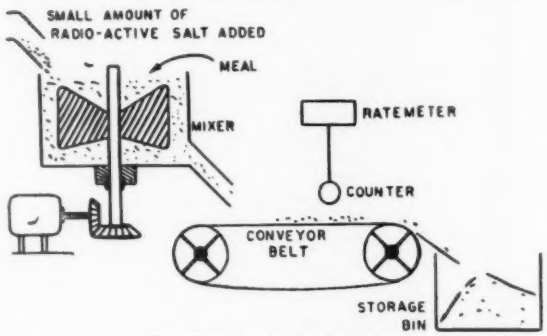


Fig. 21 Cattle food mixing

Applications to Industrial Research

Many applications to industrial research have been found which make use of the great sensitivity of methods of detection of radioactive elements.

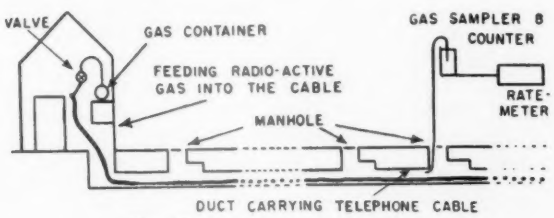


Fig. 22 Telephone cable leaks

Fig. 23 Go Devil

Thus, Messrs. Courtaulds wished to determine the distribution of lubricant used in spinning nylon thread along the thread. So a little radioactive methyl bromide was added to the lubricant and after spinning, the fibre was placed over a photograph film. On development the film was blackened in proportion to the intensity of the radioactivity which in turn was proportional to the thickness of lubricant at that point. Figure 25 shows the photograph of the distribution. As little as 10^{-10} grams lubricant per centimetre of fibre length could be detected.

Lubrication research studies have been facilitated by making a piston ring radioactive by exposing it in a pile. The radioactive iron of the piston ring is rubbed off and appears in the lubricant and on the cylinder wall. The amount of this can easily be measured by a photographic film in the case of the cylinder wall and by an electrical counter for the lubricant. In these studies, the wear of 10^{-7} grams could be measured. By this very sensitive method the time to obtain results is greatly reduced. Figure 26 shows this. Similar studies have been carried out on commercial passenger aircraft. The occurrence of excessive wear of moving parts can be detected at an early stage. This may well simplify the problem of maintenance.

Factories carrying out operations on toxic products requiring special ventilation arrangements to ensure that tolerance breathing doses are not exceeded, can make use of radioactive gases to check the dispersion of the air used for ventilation. Figure 27 shows a ventilated hood over a machine engaged on such operations. A radioactive gas is introduced at this point and measurements are made at other parts of the building to ensure that the system is effective.

Development of Industrial Applications

Figure 28 shows the growth of industrial applications of radioactive elements. Although their use is developing rapidly, we feel that we are only at the beginning of such beneficial uses.

Industrial organisations interested in using these

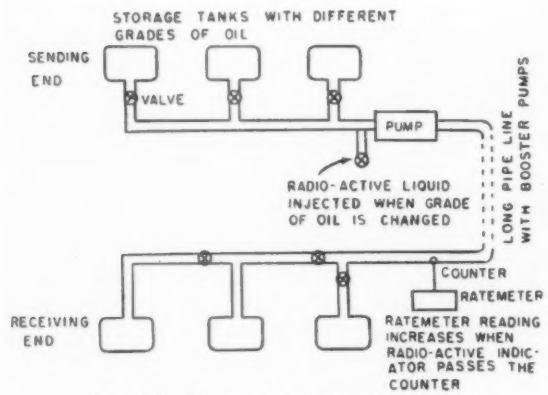


Fig. 24 Oil Pipe Line Interface Marker

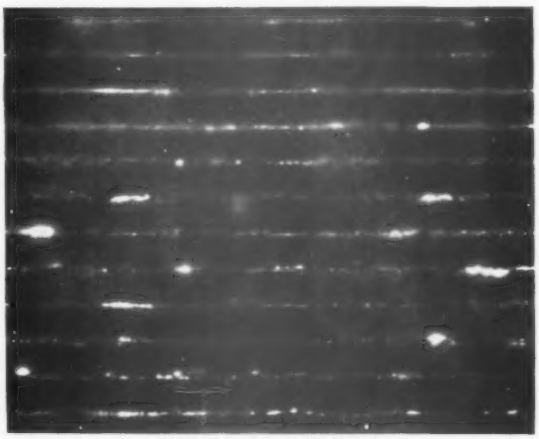
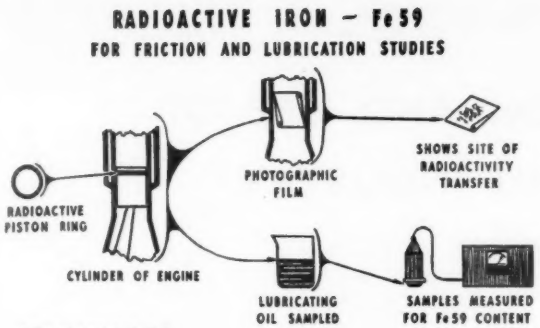


Fig. 25 Nylon lubrication


RADIOACTIVE IRON – Fe 59
FOR FRICTION AND LUBRICATION STUDIES
PHOTOGRAPHIC FILM
SHOWS SITE OF RADIOACTIVITY TRANSFER
RADIOACTIVE PISTON RING
CYLINDER OF ENGINE
LUBRICATING OIL SAMPLED
SAMPLES MEASURED FOR Fe 59 CONTENT
ADVANTAGES:
1 - TRANSFER OF METAL MEASURED TO 1/100,000 OUNCE
2 - OIL SAMPLED DURING OPERATION OF MOTOR
3 - DEVELOPED FILM SHOWS LOCATION OF WEAR
Fig. 26 Friction and lubrication studies

new tools can obtain advice from the Industrial Applications Group of the Harwell Isotope Division who are always prepared to give advice and on occasions to make preliminary investigations of possible applications for a modest fee. This relieves the industrial organisation from the necessity of buying electronic equipment before the application is proved.

We are also prepared to train industrial staff at our Isotope School which runs 4-week courses at regular intervals. This school teaches techniques and also deals with the elementary health precautions which are necessary for those using radioactive materials. These health precautions are simple and standardised and no organisation need be deterred from using radioactive elements for ' fear of the atom '.

I hope, therefore, that members of your Institution will take advantage of the many opportunities which radioactive elements now provide of increasing industrial productivity—one of the most important of our national tasks.

ANNUAL SHIPMENTS OF ISOTOPES FROM HARWELL UNITED KINGDOM

	1947	1948	1949	1950	1951	1952
Hospitals	5	49	904	1669	2801	3354
Universities	36	435	464	769	810	797
Industry	-	19	88	436	533	602
Government Departments	25	99	184	137	398	217
Agriculture and others	4	13	11	25	34	36
A.E.R.E.	65	764	1063	1273	1783	1396
U.K. TOTAL	135	1379	2714	4309	6359	6402

Fig. 28 Annual shipment of isotopes

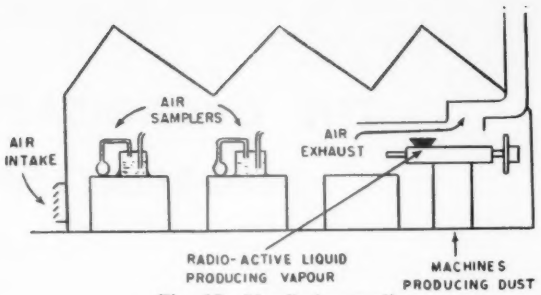


Fig. 27 Ventilation studies

Acknowledgments

I should like to make acknowledgment to many of my colleagues at Harwell for their contribution towards this article.

Acknowledgments are also due to Dr. P. S. H. Henry, of the British Cotton Research Association, for permission to reproduce Figure 20; to Mr. Avery, of the Anglo-Iranian Oil Co. Ltd., for permission to reproduce Figure 23, and to the Controller of Her Majesty's Stationery Office for permission to reproduce Figures 9, 10, 13 and 20, from the proceedings of the Isotopes Techniques Conference, Oxford, 1951.

(This Paper must not be reproduced in part or in whole without full acknowledgment being made to The Institution of Production Engineers.

Permission to reproduce any of the illustrations, must be obtained from the Controller of H.M.S.O.)

Discussion

A report of the Discussion following the presentation of Sir John Cockcroft's Paper will appear in a subsequent issue of the Journal.

Research Publications

A number of copies of the following Research publications are still available to members, at the prices stated :

Report on Surface Finish, by Dr. G. Schlesinger 15/6
Machine Tool Research and Development 10/6
Practical Drilling Tests 21/–

These publications may be obtained from the Production Engineering Research Association, " Staveley Lodge," Melton Mowbray, Leics.

THE ORGANISATION AND USE OF INFORMATION IN INDUSTRY

by G. GILFILLAN

Presented to a Joint Meeting of the Institution of Production Engineers and the Association of Special Libraries and Information Bureaux in Birmingham, 25th March, 1953.

Mr. G. Gilfillan

For the past two years Mr. Gilfillan has been a Research Fellow in the Department of Engineering Production at the University of Birmingham, where he has been engaged on research into the dissemination of scientific and technical information in Midlands industry.

After graduating in Mechanical Engineering and gaining the Associateship of the Royal Technical College of Glasgow, he served from 1941 to 1945 as an Engineer Officer in the Royal Air Force. Subsequently he joined Messrs. John Brown and Co. Ltd., Clydebank, and later Messrs. Yarrow and Co. Ltd., Scotstoun.

Immediately prior to taking up his present appointment, he completed the post-graduate Diploma Course in Engineering Production of the University of Birmingham.

INDUSTRIAL executives frequently require special information in order to solve their particular problems. A Sales Manager may have to estimate the market for a new chemical. A Production Engineer may require technical data in order to undertake the high-speed machining of steel. A Works Manager may have to find the correct anti-corrosive treatment for a certain type of ferrous metal. This kind of information and much else can often be obtained from those who have a specialist knowledge of the subject. There are also many cases in which the published results of investigations into special problems will be available in libraries.

The Department of Engineering Production of the University of Birmingham has carried out studies, during the past 18 months, into the dissemination and use of specialised information throughout Midlands industry. Particular attention has been paid to the ways in which information, especially scientific and technical information, originates and finds application.

Many persons have co-operated in this work. They include, in the manufacturing and commercial fields, the managers of local companies, the research directors and information officers of industrial laboratories and of research associations and members of the staff of the Birmingham Chamber of Commerce. Information has also been furnished by members of the staff of the University of Birmingham and by members of the Civil Service and of Government agencies.

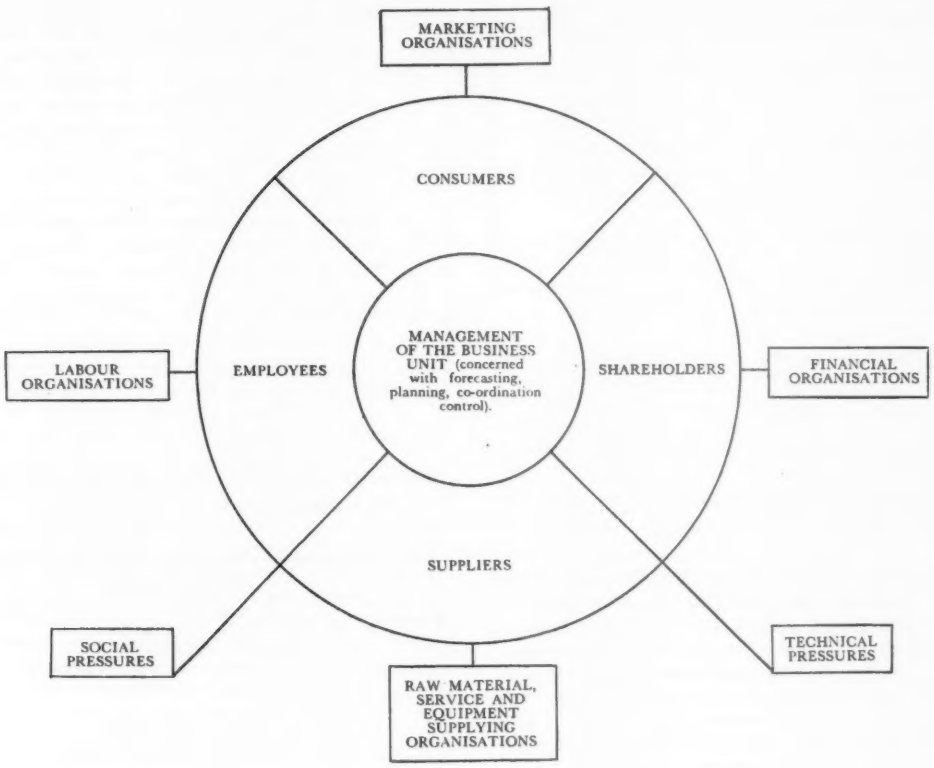
The Information Needs of Management

The number of sources from which co-operation had to be sought emphasises the variety of organisations which comprise present-day industrial society. The company, however, is the basic unit in this society. Information practice is therefore best examined in relation to the needs of company managers.

The environment of the modern business unit embraces a number of inter-related interests. These are shown diagrammatically in Fig. 1. The management of the unit is concerned with forecasting, planning, co-ordinating and controlling the business activities. In so doing, the managers must take account of the distinctive views and opinions of the four sections of the community involved in company activities.

These four sections of the community can be described as the consumers, the shareholders, the suppliers of raw materials, services and equipment and the employees. The views and opinions of these sections are expressed by bodies which represent their particular interests. These views and opinions can also be consolidated and presented in the Press. The bodies

Fig. 1 The Environment of the Modern Business Unit.



themselves can be designated as marketing, financial, supply and labour organisations. These organisations are the information sources through which management can maintain contact with the consumers, shareholders, suppliers and employees.

Management, in addition, is called upon to react to social and technical changes which take place in the course of time. These pressures, as they may be called, are evidenced by public opinion, legislation and by the effects of scientific and technical research. Many such social and technical changes are initiated by bodies which serve particular interests, or which are concerned to advance knowledge in special fields. Other changes originate from the community at large.

The company can be aided in two ways by the views, opinions and factual knowledge of outside sources. First, such information can be of help in deciding on company policy. Second, such information from outside sources can be used to assist management to carry this policy into practical effect. Management activities have, since the time of Fayol, usually been divided into six major functions. These have been variously named at different times but can be considered as finance, commercial, technical, accounting, production, and personnel. These are listed in Fig. 2.

The main aim of the general management function is to co-ordinate the other functions so that the policies laid down by the Board of Directors can be effectively implemented. This purpose can only be fulfilled if, in addition, the activities of the company are co-ordinated with those of the other elements in

FINANCIAL	e.g. provision of capital
COMMERCIAL	e.g. purchasing and sales
TECHNICAL	e.g. research, design, plant engineering
ACCOUNTING	e.g. costing, budgeting
PRODUCTION	e.g. pre-planning, materials control
PERSONNEL	e.g. recruitment, training, welfare
INFORMATION	
i.e.	the collection, classification and dissemination of information required by the organisation.

Fig. 2. Management Functions

BANKING	Joint stock banks
MONEY MARKET	Acceptance and discount houses
CAPITAL MARKET	Stock exchange, issue houses
LAND & PROPERTY	Legal firms, estate agents
INSURANCE	Insurance companies, classification societies
GOVERNMENT FINANCE	Industrial and Commercial Finance Corporation, Finance Corporation for Industry
INTERNATIONAL FINANCE	Mutual Security Agency, Colombo Plan

Fig. 3. Financial Organisations

industrial society. Certain information needs must be met if such co-ordination is to be achieved. These needs can best be examined by considering some of the organisations which form the link between the major management functions and the four sections of the community involved in the company. The agencies through which social and technical pressures are brought to bear on the company must also be examined.

(a) ***Financial and Commercial Organisations*** The basis of successful company operation is a sound financial policy. The financial organisations with which management comes into contact will therefore be examined first. Some of these are indicated in Fig. 3. They are organisations which are involved in company finance. The initial capital of a joint stock company, it must be remembered, is obtained from the shareholders. Money for the day-to-day conduct of the company, e.g., the payment of wages and the purchase of raw materials, must be obtained from the sale of manufactured goods. If sales cannot be met or if money becomes tied up in temporarily unusable form, e.g. in semi-processed parts or in raw materials, then there may be inadequate cash in hand to meet operating requirements. Such contingencies may possibly be met by securing a loan from a bank or an individual. Cash might also be obtained by encashing bills on the money market. This action would involve contact with acceptance and discount houses, merchant bankers and the like. Money required for a longer period could be obtained by issue of a Debenture. The only way, however, in which fresh money could be brought into the business, apart from using reserves built up from former years' trading, would be to approach investors through the medium of the Stock Exchange. Shares might be taken up, not only by individuals, but by organisations such as insurance companies, investment trusts, issue houses and other organisations concerned with company finance. There are, indeed, many specialised organisations concerned with the provision of company finance. Specialised organisations are also involved in the transfer of land and property and in insurance. The effect of some aspects of national and international finance will be mentioned later.

The immediate policy of the company is determined by the business and trading position. Fig. 4 lists some of the marketing organisations which serve as information sources for management. The consumer, who can be either an individual or an organisation, can be reached through one or other of several routes. The local sales organisation of the company, retailers (traders, multiple stores or co-operatives), wholesale and trade suppliers, distributive trade associations and marketing boards, are some of the channels by which consumers are supplied. The company sales staff may be called upon to assess the demand for the products. Market research consultants, can, however, be used to obtain this information. Advertising agencies and consultants may be employed to promote sales. Information about both the home and overseas market can be obtained from organisations such as the Board of Trade and Chambers of Commerce.

CONSUMERS

e.g. individuals
other companies
municipalities
nationalised industries
Government Departments

DISTRIBUTORS

e.g. local sales organisations
retailers
wholesalers
marketing boards
shipping agents

INFORMATION SOURCES

HOME	OVERSEAS
Chambers of Commerce	Chambers of Commerce
Board of Trade	Board of Trade
Trade Associations	Sales Agencies
Development Associations	Foreign Office Attachés

Fig. 4. Marketing Organisations

The practices of suppliers of raw material, equipment and services may have a considerable influence on the trading position. Some types of supply organisations are listed in Fig. 5. Raw materials may be obtained from a wide range of sources. Under present trading conditions, the activities involved in purchasing may go far beyond mere acquaintanceship with trade sources of supply and the establishment of commercial relations. The whole pre-planning of production may depend upon the tonnages of material made available by the suppliers. A high degree of co-ordination between seller and buyer may be required. If raw materials or minerals have to be procured, then purchasing activities may involve surveys of

RAW MATERIALS	other companies nationalised industries Government agencies
FUEL & POWER	British Electricity Authority Gas Council National Coal Board
WATER	Local Government Authority statutory company catchment board
TRANSPORT	British Transport Commission port and airport authorities shipping companies exporters
BUILDINGS & PLANT	architects civil and structural engineers local planning authorities Ministry of Works
SPECIAL SERVICES	managerial and technical consultants punch card services

Fig. 5. Raw Materials, Service and Equipment Supplying Organisations

world natural resources and rates of extraction. The supply of fuel and power is now a national responsibility. Management must accordingly be aware of the trends of opinion as they affect these matters at a national level. The practices of transport organisations may also have considerable influence on the trading position. Among the trading information upon which management must have information are suppliers' practices concerning trade discounts, contra-accounts, credits and returns and carriage charges. The erection of buildings and plant involve contact with various professional and legislative bodies. These include architects, builders and civil engineers, as well as local and national Government authorities.

From time to time a need for special services may arise. A large number of bodies serve industry, either on a consultant basis or by providing special facilities. These include managerial and technical consultants, punch-card services, computing and testing services, most of which are available on a commercial basis.

The financial and commercial circumstances in which the company operates are bound up with the wider issues of national and international finance and trade. Variations in the Bank Rate, Government directives setting out the conditions upon which the banks are to loan money and such actions have direct repercussions upon the policy and actions of the company. The sum total of these effects throughout industry is in turn reflected in the state of the national finance. There have also to be taken into account the arrangements made between nations to secure the flow of money and trade into designated areas of the world. Exchange control systems, and the creation of special organisations such as the Mutual Security Agency and the Colombo Plan, are among these. Overseas trade is also directly controlled by reciprocal trade agreements between nations, tariff laws, customs regulations and practice, taxation arrangements, quota restrictions and the like.

(b) ***Labour Organisations*** Personnel work has two aspects. First, a labour force adequate to meet the company's needs must be recruited and trained. Second, the morale of the force must be built up so that the potential working capabilities of the employees are realised. Some of the organisations involved are listed in Fig. 6.

Employees can be obtained directly by advertisement. They can also be obtained through the Ministry of Labour and its agencies (e.g. the Scientific and Technical Registry and the Youth Employment Service), the Universities (by way of Heads of Departments or Employment Bureaux), or through agencies such as the Public Schools Employment Bureau.

National educational curricula and prescribed standards of attainment gradually alter. Management must appreciate how the policies of bodies such as the Ministry of Education and the Board of Trade will affect the recruitment policies of the company. Company training programmes, where these exist, have to be co-ordinated with the regional and national facilities for education and training.

The importance of the human factor in industry is now recognised. Conditions of employment, wage-plans, promotion and redundancy policies, medical and ambulance services, safety organisation and training, canteen arrangements, pension and welfare schemes are among the factors which are the concern both of the company and of independent bodies. Ventilation, heating and lighting are fields in which research is being actively carried forward. Among the organisations concerned with these human factors are the Medical Research Council, the Ministry of Labour, especially the Factory Inspectorate, and also the Research Stations of the Department of Scientific and Industrial Research as, for example, the Building Research Station. The development of good working relations within the factory is an area

RECRUITMENT	The Press Ministry of Labour Universities Employment Bureaux
TRAINING	Government Departments Universities Professional Institutions
EMPLOYMENT AND WELFARE	Ministry of Labour Medical Reseach Council National Institute of Industrial Psychology
NEGOTIATION AND CONSULTATION	National Councils Employers Federations Trade Unions

Fig. 6. Labour Organisations

PUBLIC OPINION	applied by the Press
ACTS OF PARLIAMENT	applied by Government Depts. e.g. Treasury Ministry of Supply Ministry of Labour Board of Trade
LOCAL REGULATIONS & BYE-LAWS	applied by Municipal Offices e.g. Public Health Department Public Works Department

Fig. 7. Social Pressures

in which work has been done by organisations such as the National Institute of Industrial Pyschology and the Tavistock Institute of Human Relations.

(c) ***Social Pressures*** (Fig. 7). The currents of opinion and trends of thought which sweep society become consolidated and formalised in the press. Management is closely affected by such views and opinions. In time these tend to become expressed in controls and regulations which affect the individual company. Much of the best practice in industry is given legal sanction by what may be termed constructive legislation. Examples of the embodiment of desirable practices into law are given by the Factory Act and the National Insurance Act (which safeguard the interests of employees), the Company Act (designed largely to protect the investor), and the Patent Act (which safeguards some of the technical activities of the company). Parliament, it is important to note, takes cognisance of specialist bodies and the influence extended by formalised opinion. The Stock Exchange, for instance, is afforded legal recognition. A further example is provided by the legal requirements which must be met by a company which goes to the public for funds. In these circumstances, time must be allowed for informed opinion to be expressed in the financial and technical press. Much legislation is, however, of a regulative nature. The object of this is to ensure that the industrial resources of the nation are used to meet the country's needs. The Board of Trade and the Ministry of Supply are among the departments concerned with this type of regulation. There are also local regulations and bye-laws to be considered.

(d) ***Technical Pressures*** The industrial company is engaged in processing raw materials into products. Two aspects of this work can be recognised. There are the technical considerations pertaining to the design and the manufacture of the product and there is also the organisation of machines, materials and employees to carry out these activities.

Research into the properties of materials and into methods of manipulating them is being continuously carried forward. As a result, new data is established, new materials are made available and new techniques of manufacture are devised. The research sources include Research Stations of the Department of Scientific and Industrial Research, Research Associations, Universities, Technical Colleges, sponsored research institutes, commercial laboratories and company laboratories.The scientific and technical knowledge obtained as a result of incessant research and continuing experience is disseminated chiefly as published material. It is mainly in this form that it is preserved in libraries throughout the country. Management is also affected by the codification of practice which is carried out by bodies such as the British Standards Institution.

The successful operation of the company depends largely on the planning of manufacturing activities in advance of production. Materials and special tools may have to be brought in from outside sources; sub-contracts have to be placed. The methods of organising machines and employees to perform manufacturing operations are the subject of an extensive and growing literature. The analysis and improvement of the existing processes, work place layouts and manual operations used in a company have now assumed great importance. These analytical techniques are the concern of organisations such as the British Institute of Management and the Institution of Production Engineers.

The technical press plays an important part in disseminating information on new methods. Technical change is also stimulated by the evidence of progress indicated at Trade Exhibitions and by agencies such as Development Associations and Productivity Councils.

Examples of Information Work

This survey of the environment of the modern business unit indicates the types of organisations which can be used to meet the information needs of managers engaged in different company activities. Two examples will serve to illustrate how these specialist sources of information can be used. These examples have been selected from a number which were received under a Technical Enquiry Scheme operated for an experimental period by the Depart-

THE TECHNICAL PRESS	
RESEARCH & DEVELOPMENT SOURCES	
DSIR and the Research Stations	company and commercial laboratories
Other Government Departments	Co-operative Research Associations
Patent Development Organisations	Research Institutes
Universities	
Professional and Learned Societies	
COMPETITORS PROGRESS (in adoption of new practices and equipment).	
Trade Exhibitions	Anglo-American Productivity Council
Development Associations	British Productivity Council

Fig. 8. Technical Pressures

ment of Engineering Production, acting in co-operation with the Birmingham Chamber of Commerce. Under this scheme, the normal facilities of the Information and Statistical Department of the Chamber were extended to include the handling of enquiries for which no source of information was known or locally available. The enquiries were scrutinised by an Information Panel, representing regional and national information sources, which put the enquirer into touch with the appropriate source of information. The purpose of the scheme was to assess the nature and extent of the local demand for scientific and technical information and to acquaint Chamber of Commerce Members with the use of sources of information.

(a) ***Metal Corrosion*** An enquirer wrote in to ask if there was any Department at the University which could help him with a problem causing him endless trouble, particularly with his export market. He enclosed two bars that formed part of the handle of the coffin furniture sets which he manufactured. These had been corroded, apparently by acids in the wood. He explained that this wood came from Borneo and that he used off-cuts. He asked for advice as to a type of wood which would not contain acids likely to attack the nickel-plated steel tubes.

The Information Panel directed the enquirer to the Forest Products Laboratory of the Department of Scientific and Industrial Research. This organisation is listed in the directories and guides to specialist sources of information as covering all aspects of timber research.

An analyst's report was received from the Laboratory. The two handles, it was stated, contained considerable quantities of sodium chloride. It was pointed out that this had the effect of keeping the surface of the wood damp under what would normally be dry conditions and thus promoting corrosion of the steel through pores and other imperfections in the nickel plating. Under these conditions the corrosion was particularly rapid, as the salt acted as a good electrolyte. PH figures to support this opinion were quoted. The wood, it was suggested, might have been part of a baulk of timber which had floated in sea-water for a considerable period. The timber submitted was identified and some notes on this and other woods suitable, if not contaminated with sea-water, were given.

The handling of this enquiry illustrates the practical aid which managers can obtain from Government research sources. The Department of Scientific and Industrial Research, which was approached in this instance, is concerned with the industrial application of all branches of natural science. There are some fourteen research stations which cover, between them, a wide range of scientific and technical fields. The specialised knowledge accumulated at these stations is in general freely available and many thousands of enquiries are dealt with each year. The services given by the Research Stations, such as the Forest Products Research Laboratory, are supplemented by a Technical Information Service at D.S.I.R. headquarters. This service will put enquirers where necessary into contact with specialised sources of scientific and technical information.

(b) ***High-Speed Machining of Steels*** An enquirer, unable to locate any up-to-date information on the high-speed machining of steel, posed the following question :—

" In 1931 a patent, later bought by Krupps, was taken out by Dr. Salmon regarding the use of super-critical speeds when machining metals. Has any recent research been carried out regarding the use of high speeds—of the order of 2,000 feet per minute or greater—when machining plain carbon and alloy steels? If not, what information is available regarding high speed machining with particular reference to the parting off operation? "

The enquirer was referred to the Production Engineering Research Association as the main source of information in this field.

Information was also furnished by two manufacturers of machine tools. The first gave three references to periodical literature. The articles concerned dealt with the carbide milling of steel at 6,300 feet per minute, with the high speed cutting of metals and with high speed machining in general. The second manufacturer gave information on the applications of his company's tools to the finish machining of mild steel gear blanks at 2,000 feet per minute. He also referred to details of American laboratory tests at sub-zero temperatures carried out at such speeds.

Information was also given by the Mechanical and Engineering Research Organisation of the Department of Scientific and Industrial Research. The Materials Division supplied further references to articles on the subject. A note was given on the limitations of the original work on which the patent was based and some comments on the basic problems of high speed cutting were made.

The example illustrates the way in which it is possible to identify organisations at which experimental work is being carried out and the manner in which managers can, by suitable enquiry, build up information on contemporary practice. This is the first step towards the use of information sources. In this instance, before a specialist organisation could give effective aid further details of the circumstances surrounding the enquiry would have to be known. The success with which information sources can be used depends not only on the specialised knowledge which is available, but on a close understanding of the needs of the enquirer. Only thus can irrelevant information be excluded.

The Use of Information

These examples emphasise the closely integrated nature of the modern business environment. Managers are affected by Government legislation, the emphasis on the human factors in industry and the results of scientific and technical research. These are also the concern of specialist organisations representing the interests of consumers, shareholders, suppliers and employees and of agencies through which social and technical pressures are brought to bear on the company. Further studies carried out by the Department of Engineering Production, in co-operation with the executives of local companies, have yielded an insight into present managerial practices by which contact between managements and outside sources of information is maintained. Some of the methods adopted by managers who have set out to make systematic use of outside sources of information have also been studied.

(a) ***Management Practice*** In practice executives use information sources in two ways. Firstly, they use the sources to keep up-to-date with developments in particular fields. Secondly, they use the sources to seek the solution to specific problems for which the answer cannot be found within the company. In some cases the company specialists are responsible for maintaining contact with information sources. In cases where job specifications exist, these will probably embody a statement that the executive will be responsible for acquainting himself with current developments in his field and where such information affects his colleagues, he will be responsible for bringing it to their notice. In other cases, a particular executive may be charged with the responsibility for surveying current developments, usually those which are scientific and technical in nature. He is expected to call the attention of general management to relevant items of information. The attention of executives tends, however, to be confined mainly to industrial information sources, as for example, other manufacturers, trade suppliers, and industrial laboratories. It would seem that the facilities offered by specialist organisations are not always appreciated.

(b) ***Specialist Organisations*** A first task of anyone wishing to use information sources is to identify the organisations which serve his needs and understand the particular interests with which they are concerned. There are many published guides to these sources. The scientific and technical field can be taken as an example. The organisation of civilian Government research in this country is set out in "Government Organisation in the Civilian Field" (H.M.S.O.). The work carried out by the Department of Scientific and Industrial Research Stations and by the Research Associations is set out in "Brief Guides to the Research Activities of D.S.I.R. and the Research Stations" (D.S.I.R.). The research being carried out in University faculties is listed in "Guide to Scientific Research in British Universities" (H.M.S.O.). Development Associations, Trade Associations and other bodies are listed in "Industrial Research" (Dunsheath). Other sources are listed in "Records and Research in Engineering and Industrial Science" and "Facts, Files and Action in Business" (Holmstrom). A collection of such books, together with Trade Directories, the Local Chamber of Commerce Handbook and the like, are a first step towards the systematic use of information sources. New guides, as they are published, can be noted from "Aslib Information" and the collection can thus be maintained up to date. It may be useful to file the annual reports and one or two typical publications from various sources of information as a guide to their activities.

(c) ***Published Material*** Much information which interests managers and engineers is in the form of printed matter. The use of this information is complicated by two factors. The first is the large number of disseminating sources and the many libraries in which information is retained. The second is the difficulty in handling printed matter because of its volume, the diversity of publishing methods used and because the material is mainly in the form of pamphlets, bulletins and periodicals. This sets problems in filing and library technique which are peculiar to this field. The executive, however, having identified the information sources of interest to him, can find out how they publish and arrange to receive their reports. He can acquaint himself with the abstracts which cover his field. He can note the main bibliographical aids to locating specific articles. There seem to be few engineers, for instance, who are aware that virtually all technical articles are indexed in Industrial Arts Index and in Engineering Index. The executive can also note the facilities provided by specialist libraries such as those of the Research and Development Associations, the Public Libraries, the libraries of Learned and Professional Societies and the National Libraries, e.g. The Science Museum Library, the Patent Office Library and the Technical Information and Documents Unit of the D.S.I.R.

(d) ***The Information Officer*** Information work is a technique. It is a technique in the same sense as drafting or motion study. There is no reason why any person who builds up a collection of guide books to specialist sources of information and takes the trouble to acquire an elementary knowledge of publishing methods should not benefit from the systematic use of information. But information work, like other techniques, requires specialists. These specialists are the Information Officers. Their services are needed if management is to obtain full and continuing benefit from the use of specialist

organisations and published material as sources of information. The Information Officer has to sift out continually from the existing mass of information, which is constantly being augmented, the material which has application in his own organisation. He classifies and indexes this material in terms of the needs of the users of his library. He then supplies this information either to meet the demands of enquiries or, more important, on his own initiative to stimulate creative work. The final selection of the information applicable and its interpretation and use is, of course, the work of Managers, Production Engineers and other executives. In industry the work of many information officers is biased towards the handling of scientific and technical information. Industrial research may involve library research, experiment or calculation, alone or in combination. The Information Officer plays his part in this work alongside the project or development engineer and the designer. There are signs, however, that as the value of information work becomes apparent to management the scope of the work is widening. Information Officers are now being called upon to use their special library techniques and knowledge of information sources to assist management in many different fields.

Conclusions

The use of information is basically a problem in management organisation. The general management function must, in addition to co-ordinating the functional activities of the company, ensure communication between these activities and specialist bodies and sources of information outside the company. The importance of the functional activities varies in different industries and at different periods. In the same fashion, emphasis on the particular contacts to be maintained with outside sources will likewise alter. The organisational structure of companies differs with size and the personalities concerned. For the same reason, the steps which are taken to ensure the flow of information to executives will vary among companies. The extent to which management appreciates the importance of information work will also affect the level to which information techniques are developed.

Management must forecast, plan, co-ordinate and control the business activities. To do this effectively the views, opinions and practices of shareholders, suppliers and employees must be known. In addition, the effect of current and anticipated social and technical changes must be assessed. The systematic use of information provided by marketing, financial, supply and labour organisations, and the agencies of social and technical changes can do much to aid individual managers who make their own contacts with these information sources. A thorough survey of company needs is, however, likely to disc'ose the need to develop the information function as a formal management activity. In such a survey the requirements of the company are balanced against the available industrial, regional and national sources of information. The systematic use of these sources can only be fully obtained if the information function is the concern of a full-time Information Officer.

CONFERENCE ON ACCIDENT PREVENTION

The London Industrial Co-ordinating Committee has arranged a Conference to be held at the Caxton Hall, London, W.1, on Wednesday, 30th September, 1953.

The Conference will be opened by Mr. Harold Watkinson, M.P., Parliamentary Secretary to the Minister of Labour, and the speakers include Mr. C. F. Bruce, Production Engineer, Thomas Hedley & Co. Ltd. ("Accident Prevention Training Schemes in Canada and in Great Britain"); Sir Robert Hyde, Director of the Industrial Welfare Society ("The Growth and Development of Accident Prevention Work"); and Mr. H. F. Chard, M.B.B.S., D.O.M.S. ("Industrial Eye Accidents").

The proceedings will be summed up by Sir George Barnett, H.M. Chief Inspector of Factories.

Admission to the Conference will be free, by invitation. Applications for tickets should be sent to the Hon. Secretary, London Industrial Co-ordinating Committee, c/o J. & R. Fleming, Ltd., 146, Clerkenwell Road, London, E.C.1.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The Annual Meeting of the British Association for the Advancement of Science will be held in Liverpool from 2nd/9th September, 1953.

These Meetings are outstanding events in the scientific world, and may be attended by anybody interested in science, no technical qualifications being necessary.

Full particulars may be obtained on application to The Secretary, British Association, Burlington House, Piccadilly, London, W.1.

SYMPOSIUM ON TESTING AND STRESS GRADING OF TIMBER

The Joint Committee on Materials and their Testing, on which the Institution is represented by Mr. S. G. Nash, Member, has arranged a Symposium on Testing and Stress Grading of Timber, which will take place at the Institution of Civil Engineers, Great George Street, London, S.W.1, on 22nd September, 1953.

The Symposium is being sponsored by the Incorporated Association of Architects and Surveyors, 75, Eaton Place, London, S.W.1. Members of the Institution who would like to attend the Symposium should apply to the Secretary of the I.A.A.S. as soon as possible.

THE URGENCY OF SIMPLIFICATION IN PRODUCTION

by T. H. WINDIBANK, C.B.E., M.I.E.E.

Presented to the South Essex Sub-Section of the Institution on 24th September, 1952

Mr. T. H. Windibank

After service in the First World War, the author founded an electrical engineering business, Power Contracts Limited, which afterwards became associated with F. & A. Parkinson, Ltd., ultimately merged into Crompton Parkinson Limited, in 1927.

Mr. Windibank has held appointments in sales and commercial and works management, and is currently a Director of Crompton Parkinson, Limited, and Chairman of an Associated Company, Cooke & Ferguson, Limited. During the last War, he was a member of the Eastern Regional Board of the Ministry of Production, and subsequently Chairman of the Chelmsford District Committee of the Eastern Regional Board for industry, and was a member of the Government Committee for Standardisation of Engineering Products, set up in 1948.

Mr. Windibank serves on the Council of the British Institute of Management, of which he is a Founder Member.

I HAVE chosen my subject because I believe that after making allowances for all other influences, the actual consummation of Britain's future prosperity must fall in the main on the production ability of industry. Britain, early in the history of industrial development, became the largest exporter of manufactured products. The missionary zeal of our seagoing nation penetrated into the far corners of the earth and began to contribute to the uplifting of living standards of the lesser developed nations of the world. Through these pioneering efforts the markets grew and, with them, Britain's prosperity. Inventiveness, craftsmanship and cheap power were our principal assets and produced the goods that gave us the necessary purchasing power for raw materials in a free trading world. We no longer have the cheapest power and our population has nearly doubled during our century of industrial development. Other nations have learned the art of production, many with ample raw material sources within their own borders.

Our future prosperity, indeed, our economic survival, depends on our ability to compete in the markets of the world and to continue to take our share in providing the goods necessary to improve the living standards of the awakening backward peoples.

These statements are not a new realisation—millions of words have been written and spoken to the same effect and it is important that we engineers consider the action that lies in our power to grapple with the national problem.

There remains to us our traditional craftsmanship, and our men of science and invention, the equal of any in the world. Our greatest need is rapid acceleration of our production efficiency. The importation of so much of our important material is a great handicap in first costs, and must be offset by higher efficiency in the conversion process.

Some Contributory Factors

There are, of course, many contributory factors to this objective, but I suggest the most important is the reduction of variety in the range of products, the simplification of the manufacturing process and in the product itself, to satisfy the greatest percentage of the needs of the market.

In the last five years, a great deal more attention has been given by British industry to the subject of standardisation and its ramifications. Stimulation has come partly from the many visits of the industrial teams to the U.S.A. under the auspices of the Anglo-American Council on Productivity. Some evidence is offered by the fact that last year the issue of B.S.I. copies of Specifications was 845,000—more than double that of five years ago.

Since the War there come into being the I.S.O., the international organisation for Standardisation, and also the Commonwealth Standards Conferences. The former comprises some twenty-eight countries

and the latter the Commonwealth countries, of which Australia, Canada, India, New Zealand and South Africa are members with their own Standards organisations. There have also been the Conferences of the A.B.C.—America, Britain and Canada—concerned with co-ordination of Standards of essential importance for defence.

The necessity for securing our share of world markets makes the work of the I.S.O. of prime importance to us. The urgency of standardising dimensions and criteria of merit, to ensure that whether we compete with East or West we are comparing like with like, must be evident to us all.

The perils that face us in the world markets are considerable so long as there are no internationally accepted standards of comparison. The important ones are, first, from the East with the low labour costs and overheads resulting from lower living standards and E.C.A. subsidisation and, second, from the West by reason of the penetration of American standards and fashions to the countries receiving E.C.A. help. Let me say here that there is nothing but great respect and praise for this magnificent act of America to a war-stricken world, but standards take root and make subsequent change difficult.

Importance of International Standards

We have little to fear from these aspects if a measure of standardisation can be established and specialisation and simplification of our production follow. We possess all the skills for production and there are many examples in this country to prove it —all we need is a fuller opportunity to exercise them. That the U.S.A. appreciate the importance of International Standards shows through from time to time; for example, while the I.S.O. was meeting at Columbia University last June, the American automobile industry posed one of their problems. I quote "Business Week", a leading American Management Journal:

> "American car makers recently discovered to their dismay that Switzerland had outlawed sealed-beam headlights. The Swiss said the bright, long-beamed American lights blinded pedestrians on winding mountain roads. The lights also frightened cattle.
>
> "Changing the headlights of American-made cars to a type legal in Switzerland is a major job. Swiss headlights are not only a different type, but a different size. With lights built into fenders and grills, a change means practically rebuilding the front end of the car. That costs so much that Americans are on the verge of losing the Swiss market for their cars.
>
> "Faced with this, Detroit auto makers suddenly decided to join the International Standardisation Organisation, through its U.S. member, the American Standards Association. What they wanted was standard mounting dimensions for headlights. Thus the holes in the fenders would be the same size and headlights made in any country could be interchanged. This would permit cars made in one country to be sold elsewhere without risk of major alterations to comply with local laws. The A.S.A. is now trying to see what it can do."

Unified Screw Threads

Our century-old development has produced a state of mind that does not press International Standards with great urgency. An example, of which I am sure you will be very conscious, is "Unified Screw Threads". I quote our American reporter, again from the I.S.O. Conference:

> "Progress toward international standards is something like the movement of a glacier—inevitable perhaps, but so slow that it is almost imperceptible.
>
> "The U.S., Britain and Canada broke the ice in 1948 when they agreed on a standard for screw threads. Previously it had been necessary for manufacturers in each country to stockpile spare parts for machinery imported from the others. After the three countries had reached their agreement, they submitted their ideas to other nations. From this came the framework of the international organisation; I.S.O.'s first committee was set up to solve the screw thread problem.
>
> "The screw thread problem is still unsolved. The Anglo—U.S.—Canadian pact was based on the inch, the rest of the world preferred the metric scale. Still, there has been some progress. The committee has approved a profile for the thread and some types of nut and bolt heads. A compromise on thread spacing is being sought."

Very reluctantly are we moving to the new threads, due either to Services specification or the influence of dollar markets. Only the Production Engineer knows the complications of this change-over, but the sooner it is over the better. I have yet to meet the organisation which says that by a certain date all their products will incorporate the Unified Screw Thread and which is taking vigorous action to gain acceptance from home customers and so achieve full benefits from universality.

The task before the I.S.O. is enormous, but the urgency of its work is the greater because since the War Standards consciousness has grown so considerably, and in most countries Standards are being agreed in large numbers without international co-ordination. Five years ago some significant figures were published showing the relative activities of certain countries. Russia was then leading with 7,000 published Standards and a staff of 200 engineers and technicians, and were issuing new ones at the rate of two per day. France ranked second with a total of 220 staff and issues at the rate of one a day.

Britain had a staff of 176 and Standards and revisions were at the rate of 170 a year—American Standards Association at the time had a central staff of about 100.

These figures are only quoted to emphasise that Standards are being published, in great quantity, which are not international. The relative value of the work of the countries is quite another matter.

The British figure for 1951/52 for new and revised Standards was 227, an increase of 33 on the previous year. During the year, there were 45 meetings of International Committees dealing with 23 subjects.

Commonwealth Conferences

Of equal importance with the International Standards work rank the Conferences of the Commonwealth countries. Industrialisation is growing so rapidly that it is urgent that Standards be arrived at in collaboration, to obtain the best trading conditions between Britain and the Dominions. There is no doubt that valuable work can be done in this field if some Standards of an interim nature are adopted until there can be international agreement. The latter is a slow process, but interim Standards are better than no Standards at all.

A concept of the future role of Britain's engineering industry might usefully be considered at this point. There is a popular tendency to think of Standardisation primarily as concerned with mass production goods and only in that direction. This latter, of course, is not correct and not accepted in technical circles. I have shared the view for many years that the most vital function of our engineering is in the production of capital goods. In this field all the attributes of our past success are essential. We have been leaders in the invention and manufacture of production plant and machinery since the dawn of the industrial era and, as far ahead as we need to worry about, the world will be seeking machinery to make consumer goods. To fill this role we need basic International Standards. Industries such as petroleum, gas, chemical, engineering, railway locos and rolling stock, textile machinery, aircraft, mining, generating equipment, machine tools and a hundred others would meet world competition with greater efficiency if there were a greater measure of common agreement on interchangeability and performance. The work of the Institution of Production Engineers on machine tools, in conjunction with the Institution of Mechanical Engineers, is a valuable step in this direction and will no doubt stimulate the industry still further.

One of the problems that exercised the mind of the Lemon Committee was the length of time required to agree a Specification. The obvious recommendations were made to enlarge both the purse and the staff of the B.S.I., but here I think industry has to criticise itself and not the B.S.I., which we thought an efficient piece of machinery to put into effect what industry agreed upon. It is a human frailty that we are all prepared to agree to *common* Standards provided they are our own, and find it more difficult to accept those of others and sometimes even a compromise. That frailty shows through all levels, international to departmental. The rigidity of attitude of some managements turns their allegiance to Standardisation to mere lip service. Of course, sacrifice is called for in early stages, but with ultimate benefits to efficient management. The frustrations through lack of co-operation are costly not only in Committee time, but so much more in the deceleration of progress. It was estimated in 1949 that the cost of attendance of industrial representatives at Committee Meetings was £160,000 a year and Government representatives £40,000–a total of £200,000. In addition, there is an expenditure in the representatives' own offices behind their work on the Committees. What a speed-up there could be if some of the talking could be cut!

I believe that Production Engineers make the fullest use of British Standard Specifications within the limitations circumstances place upon them, but these limitations are so serious that internal standardisation and simplification are greatly retarded in many industries.

Main Limitations

The limitations which hedge in production ingenuity and simplification fall into three main considerations:

(1) The fear that initiative in design will be stultified; (2) the belief that consumers' choice is restricted and (3) the cost involved in today's high priced plant replacement and dislocation. I contend that so far from cramping design initiative, simplification and standardisation release staff to more thorough and unharassed study of the market needs and new techniques that may be applied to satisfy it. I have referred to the popular confusion of the terms "standardisation and mass production", so let us first clear the air regarding complex products such as railway locomotives. A range of models can be produced for various duties and each model is a standard, but in no sense do they approach bulk production. Nevertheless, the whole range can incorporate a large measure of Standards—parts common to all. This applies equally to a host of capital goods and surely it is commonsense to pursue both simplification and "commonality" of as many parts as possible, while standardising the model for an economic period. If this can be done and special variations resisted, the design staff can devote itself to new materials and methods to produce a new model when the manufacturing plant has been prepared, the stocks reduced to the minimum required for spares service and the market has been generally prepared for a change.

There are good examples in this country where this system exists and works perfectly, but there are far too many instances where such a clear cut practice is not adopted. For many reasons which we will refer to when discussing consumers' choice, variations are believed to be necessary and the design staff are regularly involved in defending the original theory of the design and compromising to a newly stated requirement. I say that state of affairs cramps initiative in design and not only does design efficiency suffer, but also that of the Production Engineer. The object of product design is to attain an agreed standard of performance for a specified time and within that definition there is ample scope for the designer. Trouble also arises when a number of consumers, having agreed the Merit Standard, want to specify in detail the material and manner in which it shall be achieved.

In many respects, the consumer is his own enemy in the aspect of cost reduction. The ball and roller bearing manufacturing industry will testify to the very high percentage of special types and sizes they are called upon to supply, which with designer co-operation can be filled from a standard range. This state of affairs still exists in spite of years of educational effort by the industry.

Importance of User Collaboration

Another example in which users' co-operation could speed up production, save material and reduce cost, is in the 'bus and coach body building industry. Chassis production has been ahead of body building because of the variety of operators' requirements. The railway carriage and wagon industry has a special problem, in that 60 per cent. of the output is for overseas and no attempt is made to establish a standard and persuade the user to accept it, although this is common practice in the U.S.A. Of the remaining 40 per cent. a considerable portion goes to one customer, British Railways, and it should be possible to reach a standard design in perhaps two loadings. In this, as in the locomotive industry, there is often considerable influence exercised by Consulting Engineers, too many of whom I am afraid do not assist standardisation. This record of short-sightedness of the user to the economic advantages of greater simplification of requirements can be continued almost indefinitely.

There are many encouraging examples of B.S.I. simplification through conference in the industry, such as the reduction of an unlimited variety of iron and steel sections to 117 agreed standards; limitation of tramway rails to five principal types; and cutting colliery tub wheels from 3,000 types to 17. Before 1939, photographic paper was commonly supplied in 487 different sizes. B.S.S.112, published in 1947, meets the need of British and Continental markets with 25 standard sizes. In 1949, the price of photographic paper was only 15 to 25 per cent. above pre-war, which is a tribute to the savings by standardisation.

The second criticism of fixing standards—that there will be undue restriction of consumers' choice—could have validity if user collaboration is ignored. To a considerable degree, however, this is a bogey. There are too many cases in which there is no technical reason to justify the demand for non-standard materials and components or special designs of complete equipment. There is overwhelming evidence that the customer benefits from wise standardisation at national and industry levels—usually by lower prices or better value at the same prices. One of the best known, of course, is the automobile industry, principally in America but effectively also in this country. The industry has developed the three main functions of standardisation, specialisation and simplification to a very high degree. The customer gets value for money and through periodic introduction of new models gets a wide choice. Industry will always have to sort out the purchaser's real needs from his expressed wants—they are so often not the same. It is right that industry should, for that is a first step to be sure that your product adequately meets requirements.

Customer engineering is a commonplace to many industries. The metal box trade is a first-class example of researching for the customers' real need, simplifying it and yet giving each purchaser's goods individual character. Assuming that producer and purchaser keep a sense of proportion, there is no danger of limiting a consumer's intelligent choice by standardisation.

Investment of National Resources

The third main limitation imposed on the Production Engineer is the high cost of new plant and the loss due to redundancy of existing plant. There is no doubt that investment of national resources to aid an increase of industrial efficiency would be the finest capital expenditure this country could have. How it can be achieved is a matter for the economists—there is no doubt that a further measure of tax relief for earlier obsolescence of plant would greatly help. In the meantime, engineers can consider the means to obtain the maximum return on capital employed. Whether the business specialises in component production to feed other industries or is an overall producer of an end product, whether engaged on capital goods or consumer goods, the advantages to be gained from simplification are undeniable and more or less common to all production.

The advantages fall into four main groups—with a single underlying benefit of major importance germane to all of them, namely, efficient utilisation of human effort at all levels. Important though materials may be, the greatest concern is to make the greatest use of a combination of executive, scientific and production ability.

Raw Materials and Components

In the first group, I would consider the effect of standardisation and simplification on the procurement and handling of the raw materials and components of our product. It is to this department I look first, to show me what to expect of the general organisation of the business and the place where I expect to lay the foundations of profit making. The best of design and production is valueless if material is badly purchased, if the quality or performance specifications are not accurate, if the inflow does not match the production requirement, and if the price is wrong. I use the word "wrong" in the matter of price in both senses—it can be too high and it can be too low.

The function of procurement of supplies for the production departments can only be efficient if the range of products is so clearly defined that the buying can be standardised as accurately as flow production. With these conditions, purchasing officers can build goodwill with suppliers by offering worthwhile contracts that will pay for consistent quality and delivery.

Under these conditions, closer timing and cheaper transport can be organised to reduce stocks to a minimum. An aftermath of the war has been the irregularity of supplies and has locked up capital many times in excess of real requirements with all the risks of depreciation. Big advantages accrue to buying efficiency from simplification of the product.

Design and Development

The second group, which can reap advantages for itself and confer considerable benefits on the other groups, is the design, development and drawing offices. Here lies the greatest scope for simplification; a delicate balance of design for performance and for economic production is the magic of success in this department. Primarily design and development is the inventiveness of the business, but invention out of step with competitive production means not progress but financial, that is, total disaster.

The designer must be apprised of the facilities of the Production Department and must only design within those limits. Moreover, after setting the standard of performance (it may be a national standard) which the market needs, his object should be to design the product for the greatest ease of manufacture. It is in the design department that the basic de-skilling of production should take place —given a design that is simplified, then the Methods and Production Engineers can more fruitfully apply their skill in planning the operations and utilisation of labour.

If current production is simplified and standardised, then the function of the design department can be reduced to a routine of inspection of every incoming order, to ensure that the technical requirement of the specification is within the standards laid down for the time being. Refusal to accept itinerant variations of design releases valuable manpower for preparation of improved designs to supersede current standards, as and when this becomes necessary.

Simplifying Production Methods

The third group is responsible for actual production where the materials are fashioned to the designer's theory and become the commodities which the world needs. If the Production Engineer is furnished with the right materials at the right time and simplified production designs, he is given wonderful scope to simplify his production methods.

He can plan for flow production, perhaps introducing special purpose machines and specialised tooling and plant. His costs are reduced, as he needs fewer sets of jigs and tools per unit of output and longer runs are possible on each tool setting. The burdensome and expensive task of labour training is quicker and more effective. The opportunity is given to simplify inspection, work handling, packing and transport. The finance of the business benefits because raw material and component stocks can be controlled to a minimum.

Administration and Sales

The fourth group to benefit from simplification is that which covers the administration and selling function. Overheads come down as production plant is efficiently loaded, supervision costs are reduced and service simplified. Selling can perform an educative function of value to the user and be a source of information to the design departments. Managements could take a much more critical attitude to market requirements and by wise selection of a range of products and clear direction of the sales efforts, funnel a high proportion of deviating demands into a more limited channel of standardised products. This policy can be greatly stimulated if there is a proper segregation of the relative production costs of the fast selling and slow moving lines and realistic interpretation in the selling prices. Realism means that not only do the special requirements attract the mere extra cost of material and production time, but also the related special costs of individual attention of designers, production planners and commercial departments. To this must be added the cost of the disproportionate amounts of time to be spent by Works Management, Supervision, Inspection, Stores personnel and often Packing and Transport. Then add the nuisance value of dislocation and error. Naked truth of this kind will come as a shock to many, but it will bring home the real values of simplification to the place where most people notice it most—the trouser pocket. Standardisation should be examined for what it adds—not in terms of what it takes away.

There is the problem of simplification as I see it —not *all* of it is within the scope of Production Engineers, but a vital part of it is.

We are inclined to grow used to the good examples in our own country and it has been valuable that 47 Industry Teams have been able to see examples in the U.S.A. The Anglo-American Council on Productivity say, in the Report on "Simplification in Industry":

> "We are convinced . . . that an organised and determined effort to reduce our manufacturing variety still further could make a rapid and major contribution to increasing productivity and lowering costs in British industry."

RESIDENTIAL COURSES FOR INDUSTRY

A new brochure issued by Burton Manor Residential College for Adult Education states the aims and methods used in their Residential Courses for Industry, lists fifteen different types of courses held at the College, and gives dates and fees for 31 courses during the period June 1953/March 1954. Since the College was opened in 1948, 144 firms have made use of the facilities offered.

Copies of the brochure and any other information desired may be obtained on application to the Warden, J. B. Newton, M.A.

THE TRAINING OF SUPERVISORS

by J. R. ARMSTRONG

Chief Education Officer, Joseph Lucas Ltd., Birmingham.

Presented to the Western Section of the Institution, 19th January, 1953

MY main problem in preparing this talk lay in an endeavour to present something new, and I find that most of the things I am going to say have been said before. However, I believe that there are some fundamental principles in Supervisory Training that need re-emphasising and re-stating.

Many companies today are rapidly facing up to situations that threaten to form a ceiling to the range and profitability of their operations. At the same time, vast new areas are opening for development in fields that were hardly dreamed of fifty years ago. New materials and new techniques are creating new markets and new trends. The companies that will profit from these conditions are doing the groundwork today for the production and sales they will achieve tomorrow. But, strangely enough, the limiting factor in our plans and programmes lies not merely in money or machines but also in the supply of men with potential management and supervisory ability. Good men are harder to find than pounds, shillings and pence. There just is not sufficient potential management ability available and the most successful companies will be those who succeed in getting better results out of the people they have already. I believe that this results in a new meaning and a new scope for training and training programmes.

Change in Outlook

Just a few years ago, many training programmes were looked upon as a luxury. They had no real function in the organisation, but were regarded as gadgets that could be used to improve a nebulous something called "morale". During the past few years, however, great changes have taken place. Industry has been faced with steadily growing pressure for increased production and it has had to accomplish this by using smaller and less experienced working forces. Training programmes, therefore, need to be more realistic. They have got to put on overalls and get to work on the shop floor. They have got to be working tools and help to improve production in the same way as time and motion study, job evaluation, merit rating, etc.

In order to have a complete appreciation of the needs of supervisory training, we must consider the position of the foreman in industry. The foreman's job has changed and indeed is still changing. He has got to be a real management man, fully aware of the company's policy—of his position in the organisation, and the place he occupies in the overall structure. He must be able to associate himself with things that happen and know why they happen.

I was fortunate enough to be a member of the Anglo-American Productivity Team that visited the United States of America in 1951 to look at supervisory training over there, and since there are many aspects of training that can be discussed, I feel that I can best serve you by taking up four points from the Supervisory Training Report which was published after our visit.

Four Important Points

I have chosen these points because I think they are essentially practical, and have a real bearing on improvement in productivity:

Firstly—Training should be done mainly within the company in terms of its own policies and practices.

Secondly—Members of the line organisation should be responsible for the application of training, which should be looked upon as a tool of management in the normal operations of the company.

Thirdly—The necessity for group training activities should not be allowed to obscure the importance of individual training and guidance.

Fourthly—Training in "Human Relations" should be brought to the fore in all training programmes.

Let us take the first of these four points—that is, that "Training should be done mainly within the company in terms of its own policies and practices".

The really successful training programme cannot be superimposed on the management group. It serves little useful purpose to use a package programme or bring in some outside agency to do the training for you. Similarly, it is just as useless for the training staff to retreat to their ivory castle and develop the kind of programme that they consider to be necessary. If training is to grow out of the policy and practices of the company, it must be accepted and used by the entire management group.

I am emphasising here that it is dangerous to label training as Supervisory Training and to exclude other management groups from the process. This danger does not arise because supervisors do not like training, or are not anxious and interested to learn—indeed, I am surprised to find how keen and enthusiastic they become. But training takes a lot of time,

much of it spent off the job, and the foreman assumes that his boss and his boss's boss know all about, and practise these fine new principles which are being taught. But, one day, the foreman finds out that other people know little about the training schemes and what is more, practise very few of the principles that are being taught. Under these circumstances, the foreman will still attend training classes and will be there in body but not in mind. Training must start at the top and all levels of management, including the foreman, should help in establishing the training programmes and participate in the development and follow-up.

Residential training courses run by the company are invaluable in this respect. Formen can readily see management's attitude towards training. The fact that they are prepared to grant him company time in which to train, opportunity for him to meet executives of all levels, and facilities for him to exchange experiences with his fellow-supervisors, help him to appreciate management problems and to understand the other man's job in situations arising out of the normal operations of the organisation.

The second key principle I mentioned was the responsibility of all members of the line organisation for the application of training.

Training is sometimes looked upon as something that is a good thing to do "when there's time". Many supervisors we know come along to T.W.I. Training Courses and are sold on the value and necessity of carrying out this training, but limitations are imposed by "If I've got the time". As an analogy to this situation, let us consider the executive who buys a new type of machine to help improve production. But once he gets it, he does something rather odd. He puts the machine in a separate room at one side of the plant. Then he locks the door and causes to have erected thereon a sign stating "This machine to be used only every Thursday from 2.00 till 4.00 in the afternoon." We can well appreciate the stupidity of that sort of thing, but it has a parallel among supervisory training programmes which have their beginning and ending in the conference room where supervisors meet on occasions. Training must not be just "a shot in the arm"—a reviver or pep talk, or a week-end conference that is being held by the sea—usually in the summer months. Training has got to be a function *of* the line organisation *for* the line organisation and *by* the line organisation. If this is to be done, it is necessary of course for line supervision to have the ability to get ideas across. They must be able to express themselves—they must cultivate the art of listening and better understanding; they must learn to ask questions instead of giving the answers. Discussion group leading is a valuable means of doing this and I do recommend that every supervisor has some skill in this direction. This method is valuable also because the foreman who learns to think logically in a group, will tend to think logically as an individual later on when confronted with those problems on the shop floor.

Individual Needs

The two points I have made will help in establishing training as a means of developing supervisors as a group. It is important, however, that while we are raising the general level of supervisory efficiency, we should also be doing something about developing specific men for specific jobs. There is no easy answer to the problem of determining individual needs, but I believe that as supervisory training develops, it can take on some of the responsibility for the perpetuation and growth of the management body. This matter of picking out individuals, finding their weak points, counselling them so that they can do better, must be one of our major objectives in the immediate future. The individual history sheet, the performance reviews, are all effective aids in developing this sort of training.

When a man is recognised, appraised and coached as an individual, it sets him a target to aim for, and because he knows he is going somewhere, he is likely to make the extra effort needed to get there a little faster.

My last point was that training in "Human Relations" should be brought to the fore in all training programmes. We have been inclined to say that with mechanisation there is less need for supervision to be skilled in handling people. In point of fact, of course, it is exactly the opposite. The more we mechanise and the more technical improvements we introduce, the greater skill supervision must possess in the handling of people.

It is generally accepted that 80% of a supervisor's job lies in working with people. This includes people who work beneath him, on a level with him and those above him, and I believe that the greatest problem facing industry today lies in our ability to handle people better. Both workers and supervisors point out that handling people is their superior's chief weakness, but isolation of the problem does not give us the answer. We have got to take more vigorous corrective action.

We must, then, give supervisors opportunity to make mistakes, to recognise mistakes when they are made, and an opportunity to practise until they are competent to use their new skill with an assurance on the job. Many new developments in training methods have provided an opportunity to do this, such as the Case Study Method, role-playing, and group discussion leading. In my own company, we are conducting a two-week full-time residential course in "Human Relations". We never attempt to tell the supervisor what or what not to do—in any case, we don't know—but we do provide him with the opportunity of re-assessing and re-evaluating his experiences. Supervisors must recognise what is wrong with the things they are doing now. They must recognise what effect their actions have on the people they work with. They must recognise for themselves and this does not mean "being told", how their behaviour needs changing—and of course, there must be a desire to change. A conviction that personal gain will result from improved human relations is necessary, and this will involve changes in attitude.

(concluded at foot of next column)

NEWS OF MEMBERS

MR. R. K. FLEMING

Mr. R. K. Fleming, Member, has relinquished his position as Managing Director of the Igranic Electric Co. Ltd., Bedford, and has been appointed Chairman of the Company in succession to Mr. G. R. Thursfield.

MR. H. D. S. BURGESS

The many friends of Mr. H. D. S. Burgess, Member, of the Coventry Section Committee, will be pleased to learn that he has now returned to business after his recent spell of ill-health.

PROFESSOR T. U. MATTHEW

The recently opened Institute of Engineering Production, Birmingham, has been placed under the direction of Prof. T. U. Matthew, Member, Lucas Professor of Engineering Production at the University of Birmingham.

The establishment of the Institute has been made possible by a gift of £57,400 from Joseph Lucas & Co. Ltd., with the aim of providing a centre for continued studies in engineering production and management, by means of short residential courses for executives in manufacturing industries

MR. E. W. HANCOCK, M.B.E.

Mr. E. W. Hancock, M.B.E., Member, has been appointed Chairman of the local Productivity Committee for the Coventry area. Mr. Hancock is Director and General Manager of Humber, Ltd.

MR. A. F. WILLIAMSON

Mr. Arthur F. Williamson, Member, has been elected Mayor of Lytham St. Annes for the ensuing year.

NEW APPOINTMENTS

Mr. A. W. Black, Associate Member, has now taken an appointment as Production Controller with Ace Manufacturing Co. Ltd., Durban, South Africa, on a consultancy basis.

Mr. D. C. Boak, Associate Member, Materials Handling Engineer to The Ford Motor Co. Ltd., has recently been appointed a member of Council of the Institute of Materials Handling, and was elected Chairman of the Southern Division.

Mr. R. N. Cook, Associate Member, has now relinquished the position of Assistant Works Manager at the National Gas & Oil Engine Company, Ashton-under-Lyme, in order to take up an executive appointment with Wickman Ltd., Coventry.

Mr. John Ford, Associate Member, Midlands Manager of Paterson Hughes Engineering Company Limited, Edgbaston, Birmingham, has recently been appointed to the Board of his Company.

Mr. J. France, Associate Member, has joined Barton, Griffiths & Co. Ltd., (B.S.A. Small Tools Group) as Technical Sales Representative covering part of the Yorkshire area.

Mr. J. R. Haag, Member, is now Works Administrator with Dyson & Co., Enfield (1919) Ltd., Enfield, Middlesex.

Mr. J. A. Hartley, Associate Member, of the English Steel Corporation Ltd., Manchester, has been appointed Senior Assistant to the Sales Manager and will be responsible for sales promotion and supervision of all areas throughout the British Isles.

Mr. J. A. Land, Associate Member, has been appointed Project Planning Engineer to the Overseas Companies Division of Rootes Ltd., London. Mr. Land recently resigned his position as Chief Engineer with Hindustan Motors Ltd., Calcutta.

Mr. H. Low, Associate Member, is now General Manager of J. P. Fielding & Co. Ltd., Salford.

Mr. A. McDonald, T.D., Member, has recently relinquished his position as Chief Engineer, Hoover (Washing Machines) Ltd., to take up an appointment with Simplex Electric Co. Ltd., Blythe Bridge, Staffs.

(*continued from page* 368)

Professor Roethlisberger of the Harvard Business School says: "It is not people's ignorance that gets them into trouble, but what they know that ain't so."

I believe that the four points I have underlined, are characteristic of the new attitude to training which is now being understood and that, although techniques may change, the basic principles appear to have considerable permanence.

We have got to see that training is accepted by the supervisor as being as vitally important to him as the rifle is to the soldier.

If we develop these principles of training, management development and management efficiency are bound to result.

Mr. K. Barry, Graduate, has taken a position as Production Planning Engineer in the Turbine Blade Section of Hepworth & Grandage (Yeadon) Ltd., Leeds.

Mr. W. J. Botting, Graduate, has taken up an appointment as a Planning Engineer at the Liverpool Works of D. Napier & Son Ltd. Mr. Botting was, until recently, a member of the Reading Section Committee.

Mr. W. F. Brade, Graduate, is now a Senior Planning Engineer with the Rootes Organisation (Commer Cars, Luton).

Mr. J. I. Dennison, Graduate, is now Production Engineer with Dowty Equipment Ltd., Cheltenham.

Mr. N. J. Elander, Graduate, has now taken up an appointment in the Production Facilities Department of General Motors South African Ltd., Port Elizabeth.

Mr. E. J. Grossmith, Graduate, has taken up an appointment as Process Planner with A. V. Roe (Canada) Ltd., Toronto.

Mr. F. W. Nicholls, Graduate, has resigned his appointment with Messrs. D. M. Mann & Co., Eye, and has rejoined Ransomes & Rapier Ltd., Ipswich, as Assistant Production Engineer.

Mr. G. W. Voaden, Graduate, is now employed as a Designer/Draughtsman at F. Bode & Son Ltd., Leek, Staffs.

I.C.W.A. SUMMER SCHOOL

The Fourth Residential Summer School of the Institute of Cost and Works Accountants will be held at St. Catharine's College, Cambridge, by courtesy of the Master and Fellows, from 21st to 26th September, 1953.

Speakers will include Dr. J. M. S. Risk, Chief Accountant, Southern Gas Board, who will deal with the financial control of large-scale organisations, with special reference to public authorities; Mr. A. D. Coventry, of the Industrial and Commercial Finance Corporation, who will discuss "Finance and the Cost Accountant"; Mr. R. Y. Kennedy, Cost Accountant of Winsor and Newton, Ltd., speaking on "Comparable Costs"; and Mr. Harold Wincott, Editor of "The Investor's Chronicle".

Delivery of the Papers will be followed by group discussion, and two works visits will be made during the proceedings, which terminate on Friday evening with the Annual Summer School Dinner.

Further particulars of the School may be obtained from the Institute's Head Office at 63, Portland Place, London, W.1.

CORRESPONDENCE

From: H. Andrews, Managing Director.
Harold Andrews Grinding Co. Ltd.,
Birmingham, 29.

"FUTURE PROSPECTS OF THE PRODUCTION ENGINEER"

I have read with interest Mr. Walter C. Puckey's paper in the May issue of your Journal, and I was interested to note his remarks regarding the continuous casting of metal.

I would like to point out that far from being on the fringe of utilisation, my company is operating the continuous casting process on a production basis with particular reference to cast iron.

This process is long past the experimental stage with us, and is in very great demand, both on account of the excellent quality of the material produced, and the fact that it can be supplied in bars up to 8 feet long in the centreless ground condition, and that it can be used in high production machines, such as Multi-Spindle Automatics, which has been impossible up to the present owing to the non-availability of bars of cast iron in this length.

Incidentally the material in question is actually advertised in the same issue on page xlix.

Correspondence is invited on Papers published in the Journal, and should be addressed to the Editor, 36 Portman Square, London, W.1.

Visual Aids in Industry and Commerce

It is announced by the Wandsworth Technical College that practical courses will be held during the 1953/54 Session, as follows:

1. The Operation and Care of Optical Projectors.
2. Preparation of Graphic Materials and Technical Illustrations.
3. Photographic Techniques in the Drawing Office.
4. Motion Study, Photographic Techniques.

Full details of these courses may be obtained from the Secretary (Visual Aids), at the College.

FORTHCOMING EVENTS 1953.

Summer School, Ashorne Hill, August 26th to 30th.
Graduates Convention, Birmingham, September, 5th.
Institution Annual Dinner, October, 9th—Guildhall.
Worcester Sub Section Inauguration, October 10th.
Sheffield Section Dinner, October, 12th.
Western Section Dinner, October, 15th.
Coventry Section Dinner, October, 30th.
Lincoln Section 10th Anniversary Dinner, Nov. 5th.
George Bray Memorial Lecture, Leeds, Nov. 9th.
Nottingham Section Dinner, November, 18th.
Viscount Nuffield Paper, London, December, 16th.

HAZLETON MEMORIAL LIBRARY

Members are asked to note that the Library will normally be open between 10 a.m. and 5.30 p.m. from Monday to Friday each week. During the month of August, full facilities will not be available at the following times :—

Monday, 3rd August all day. Thursday, 13th August all day.

Tuesday, 25th August from midday.

It would be helpful if, in addition to the title, the author's name and the classification number could be quoted when ordering books.

658.54 TIME AND MOTION STUDY

" Work Measurement : New Principles and Procedures " by Adam Abruzzi. *New York, Columbia University Press. London, Oxford University Press,* 1952. 290 *pages.* £2. 0. 0d.

The Author describes current problems in Work Measurement, particularly as associated with United States practices. He contrasts the current method of handling the problems associated with these practices against his own statistical approach.

In the opening chapters, the Author quotes liberally from the work measurement and statistical literature in illustrating these problems, and at the same time takes up several opposing viewpoints. At this stage, he points out that many of the so-called scientific procedures are intimately associated with collective bargaining and that both management and labour have interpreted and used the results to advance their own interests.

From liberal quotations of other texts throughout the book, the reader is able to follow up on any particular topic mentioned, and obtain additional facts regarding the various viewpoints.

The Author makes liberal use of statistical quality control methods and other statistical techniques applied to Time Study. He presents a statistical approach for handling the problems of work measurement and adopts an objective rather than the subjective method (use of rating factor). The use of a rating factor, i.e. subjective approach, is severely criticised. The statistical approach is illustrated in detail by experiments carried out in American clothing manufacturing companies of contrasting efficiency. This industry was selected for the experiments as the operations are, in the main, man-controlled. These experiments had the support of the International Ladies Garment Workers Union of the U.S.A.

Regarding the compilation of standard data, the Author states that " the overall implication of these facts is that element (more properly, element groups) standard data is apparently an impossibility for all operations in which the worker exercises an appreciable influence on the work method and work pace ". Similarly, he renders false the argument that when a change is introduced, only that part of the operation affected should be revised, as all individual motions or elements are related to the complete motion and element pattern.

This book questions the validity of several basic ideas, for example, " The One Best Way ". It does, however, require concentrated reading and an understanding of statistics, but contains much of interest to the serious Work Study Engineer. Its various hypotheses and their implications should be read and understood by all persons associated with work measurement. G.R.B.

621.776 EXTRUSION

" Extrusion of Plastics, Rubber and Metals ", by Herbert R. Simonds, A. J. Weith and W. Schack. *New York, Reinhold Pub. Corp.,* 1952. 454 *pages, illus. diags.* £4. 0s. 0d.

This volume, it is stated in the preface, is the first book published on the subject of extrusion of plastics and may therefore claim special attention on this account.

The complete process of extrusion both for plastics and metals is dealt with in a very authoritative manner. Part (1) of the volume, comprising 15 chapters, deals essentially with plastics, starting with the early wet extrusion machines in 1870, up to the modern dry screw equipment which has been finally perfected during recent years.

The early chapters are devoted to a full explanation of the continuous extrusion process, followed by design details covering the most modern equipment, together with the most important factors on die design and running conditions to obtain efficient production. Various types of materials available are reviewed, such as cellulose acetate, nylon, ethyl cellulose, polystyrenes, vinyls, and full details given of the production conditions necessary. Under this heading is a chapter on preparation of the raw material and the proper use of plasticisers.

Full explanations are given of the methods employed for extruding sheet, tubing and mono-filaments, also wire covering. In this latter application, attention is drawn to the increased usage of plastics in place of enamel and rubber. The authors have also tabulated considerable information on specifications and process control.

Part (2) deals with the extrusion of rubber, metal and miscellaneous materials. Descriptions are given of the various synthetic rubber materials that have recently been developed and also details of manufacturing processes for insulation of cables and car tyres. A chapter is also devoted to the lead sheathing of cables, which is one of the earliest applications of the extrusion technique.

Much useful information is given for the continuous extrusion of aluminium and magnesium sections, also on die design and methods employed for impact extrusion in aluminium and copper.

The work concludes with reference to some of the latest types of extrusion forging which is being carried out; also examples of both hot and cold extrusion of steel. Although this volume is primarily of interest to the specialists, it can be confidently recommended as a first rate text-book on extrusion technique.

H.L.H.

658.5423 MOTION STUDY

" The Purpose and Practice of Motion Study " by Anne G. Shaw. *Manchester, Harlequin Press,*

1952. 311 *pages, illus. diags.* £2. 10s. 0d.

Miss Anne G. Shaw has considered the pioneer work of the Gilbreths in perspective with modern thinking and in the opening chapter considers also the approach of Taylor. The historical aspect is, however, only pursued far enough to place the present developments in their correct setting.

Throughout the whole book, a commonsense practical approach has been taken and the various techniques of motion study have not been considered in isolation to the cost of the investigation and the ultimate savings.

The human approach is considered to be very important and the need to adopt the correct psychological approach for the successful introduction of a new method is stressed.

It is stated that the techniques of Process Charting and Micro-motion study, fully described, consider only a series of individual movements and are used as a means of analysis, whilst they do not consider the pattern of movement for the economy of fatigue. This aspect is dealt with fully under the chapters dealing with the path and characteristic of movement.

The broader aspects of the workplace and factory layout are considered and also considerable importance is given to the correct installation of the new method. The final chapters of the book deal with a Motion Study Training Programme, and operator training, whilst in the Appendices the necessary routine for an investigation is considered. Also eight practical examples, fully described and illustrated, of the application of motion study in a variety of industries are given. The text also gives many practical examples of motion studied methods and there are a considerable number of footnotes for further reference. G.R.B.

331 LABOUR

"The British Worker" by Ferdinand Zweig. *Harmondsworth, Penguin Books,* 1952. 243 *pages.* 2s. 6d. (*Pelican Book.*)

Experienced Management in this country fairly understands the British worker. Aspirants to executive functions in industry need an intimate knowledge of the predominant force they will be required to guide and control. Closer ties developing among the nations demand ever-increasing comprehension, each of the other's traditional background, attitude, conditions and idioms. The student, British or foreign, will find in the pages of this book a concise and factual presentation of the British worker as he is, not as he is often supposed to be, nor as we may wish him to be. Profound truths are expressed without ostentation. The work is a valuable record of patient research, set out and co-ordinated in such a manner as to aid the understanding of the student by supplying the food his intelligence craves. The sociologist will appreciate the contribution it makes to his studies, which would be incomplete without a like intensive research in the field.

Chapters such as "The Past in the Worker's Mind" and "Monotony in Industry" instance causes of frustrations to progress and explain some of the almost unbelievable contradictions in workers' behaviour. "The Qualities of the Model Worker" is an honest exposition of the typical ideal British worker. C.R.W.

744 TECHNICAL DRAWING

"Drawing Office Organisation : Formerly BS 1100 : Part 9." *British Institute of Management, London. Rev. ed. London, the Institute,* 1951. 40 *pages.* 5/-. (*Production Management Series* 4.)

This B.I.M. booklet is a revised version of one of the "imitation" war-time B.S.I. "1100" series—actually B.S.1100/9.

A useful little handbook for the now technical executive whose work involves a knowledge of the drawing office organisation.

Section-leaders and checkers in Drawing Office work may find some new ideas herein, but most of the content is of well-tried techniques. K.R.A.

519.2 STATISTICAL METHODS

"Industrial Process Control by Statistical Methods" by John D. Heide. *New York, McGraw-Hill,* 1952. 297 *pages, diagrams.* £2. 11s. 0d. (*Industrial Organisation and Management Series.*)

In this book the author goes into great detail to explain the whole theory of the production of statistics and to show the various methods of presenting these for later use; he then proceeds to show how these results may be applied to practical methods of controlling production within given limits. He points out the various technical problems that are likely to be encountered and he shows how the results should be evaluated and interpreted. Each section concludes with a number of practical problems for the student to work out, and there are several appendices which expand certain sections of the work and give useful tables and a glossary of terms.

This is a book for those who wish to study the theory of statistics and, from an intelligent study of the work, it should be possible to design a system suitable for any particular problem. It must, however, be borne in mind that no system will, in itself, improve the product; it can only show the state of things as they are and indicate where improvements can be made.

Many of the methods suggested would be over-elaborate once the production flow had settled down, but they would be useful in an initial investigation and, with the sound basic knowledge of theory to be obtained from this book, it would be possible to evolve a simpler system for regular use. One must beware of creating a system which is more trouble to operate than it gives benefits in return, and there is a danger that an enthusiasm for interesting graphs may lead one astray from the real business of producing better quality, in greater quantity, more cheaply; one must also beware of trying to make the job fit the system rather than the reverse.

The book is well written and planned, but time is needed to digest its contents and it will not give a ready-made answer; this is as it should be, because every different problem requires careful analysis to find out what one is trying to control and how it can be achieved. R.M.E.

621.74 FOUNDRY PRACTICE

"Investment Castings for Engineers" by Rawson L. Wood and Davidlee Von Ludwig. *New York, Reinhold Pub. Corp.,* 1952. 477 *pages, illus., diags.* £4. 0s. 0d.

This book offers an unusually comprehensive description of the salient features, advantages and limitations of investment castings as they are now employed in the metal working industries. For the engineer who is on the fringe of investment casting, it is an ideal book for day-to-day reference.

The first half of the book discusses the materials and methods employed in producing investment castings and, as such, is particularly useful to foundrymen. The Authors do not go into intimate details of individual processes, as these are usually zealously guarded and, in fact, constitute the know-how of the individual Company producing castings by these methods. There is a chapter devoted to the use of wax *versus* plastics as the medium for the expendable pattern and two chapters are devoted to the Frozen Mercury Process which, incidentally, has not appeared in print before. The Authors discuss the master pattern and the die, for which the expendable pattern is made, giving examples of those jobs for which soft metal dies can be made and those for which steel dies should be made. The technique of gating, risering, clustering and venting of wax and plastic patterns is outlined. Investment materials and techniques are indicated and the melting and casting of alloys used, together with the finishing operations of investment castings, is well written.

The second half of the book deals with the selection

of ferrous and refractory alloys in order to ensure that the designer selects the right material for the right job. Many examples are given on product design development and castings to replace fabricated parts. Some metallurgical observations and machineability tests on stainless steels are also given. A chapter deals with the dimensional accuracy one can expect from an investment casting and how to machine such castings. A.S.

ABSTRACTS

519.28 OPERATIONAL ANALYSIS

" Methods of Operations Research " by Philip M. Morse and George E. Kimball. *1st ed. rev. Cambridge, Mass. Technology Press of Massachusetts Institute of Technology ; New York, Wiley ; London, Chapman & Hall,* 1951. 158 *pages. Diagrams.* £1. 12s. 0d.

The objects and aim of the book are to set down an approach to problems by scientific and mathematical methods, mainly using the theory of probability and statistics, in order to predict results, rather than merely ascertaining statiscally what has happened afterwards, when data has become available. It deals mainly with military applications of Operations Research, but is intended to enable parallel non-military applications to be drawn by the reader.

Chapter 1 defines the subject and its value. One or two non-military examples are given which show the scope of application of Operations Research. The problem of finding the problem is significantly mentioned. Mathematical prediction and personnel and their organisation is briefly dealt with.

Chapter 2 fully covers the Theory of Probability, various Distribution Laws and Sampling ; these are related to military problems, and discussed.

Four chapters deal with Measures of Effectiveness, Strategical Kinematics, Tactical Analysis, Gunnery and Bombardment Problems respectively. Each of these chapters is concerned with the application to military problems of the theories contained in Chapter 2. Similarly, Chapter 7 covers the Planning of Operational Experiments, and then the calculation of the accuracy of the experimental measurements related to further military examples.

Organisation and procedure are dealt with more fully in the last chapter.

There are several sets of Tables for use in connection with the statistical solutions of problems set out in the book, and also Distribution Tables derived from the various formulæ used.

669.2 NON-FERROUS METALS

International Materials Conference, Washington, D.C.—Joint Sub-Committee on Utilisation. **Utilisation of Manganese, Nickel, Cobalt, Tungsten, Molybdenum:** First Report of the Joint Sub-Committee. *Washington, The Conference,* 1951. 94 *pages. Mimeographed.*

In view of the urgent need for conservation of steel hardening materials due to acute world shortages, and following on decisions made by the Manganese—Nickel—Cobalt and Tungsten—Molybdenum Commitees of the International Materials Conference, each government represented on those Committees was asked to provide up to three experts on technical matters related to the utilisation of the five elements of manganese, nickel, cobalt, tungsten and molybdenum to form a Joint Sub-Committee of experts on utilisation.

The Sub-Committee had as its Chairman, Mr. K. H. J. Clarke (Canada), as its Vice-Chairman, Mr. F. F. Franklin (United States). The Report has been prepared by a drafting group under the chairmanship of Mr. E. H. Bucknell (United States), and it summarises the results of a series of meetings which were held between June 11th and July 18th, 1951, and covers the following subjects:—

Ferro-alloys and other Sources ; Steels and Irons ; Non-ferrous Alloys; The Pure Metals; Catalyst Chemicals ; the Scrap and Salvage Situation.

Appendices: I. Special Session with United Kingdom Special Group on Conservation of Raw Materials (Engineering Industry).

II. United Kingdom Nickel Prohibited Uses ; United States List of Prohibited Uses and Nickel-plating.

III. Boron-treated Steels and IV References.

621.791 WELDING ; CUTTING

" Resistance Welding Data Book : Theory and Practice " by P. R. Mallory & Co. Inc., Indianapolis, Ind. 4th ed. *Indianapolis, the Company,* 1951. 510 *pages. Illustrated. Diagrams.* $3.00.

This publication, in eight sections, deals with all aspects of electrical resistance welding.

The first section deals in detail with the fundamental principles of nine types of resistance welding processes. The technicalities of machine types with wiring diagrams and operational sequence are propounded with extreme clarity. Then follow sections on resistance welding controls ; current magnitude and time ; sequence timers ; pressure controls ; power supply and switching devices.

The third section is devoted at length to materials to be welded. All weldable materials are dealt with, including the welding of dissimilar metals. The next two sections explain various electrode alloys, electrode types, dies, holders and resistance welding tooling methods. The brazing of hard facing alloys for electrodes and the heat treatment of copper base electrodes is included in a small section.

The last two sections give the welding engineer recommended practices for the various resistance processes, including testing methods. This is presented in table form for all types of materials and thicknesses, i.e. electrode diameter and shape ; electrode force ; weld, quench and temper times ; welding and temper currents ; weld spacing and material overlap ; fused zone diameter and joint strength, is an example of one such table for spot welding.

The book finishes with tables and data including machine maintenance, welding definitions and the physical properties of metals.

The whole work is illustrated with photographs and diagrams in all sections.

This book was presented to the Hazleton Memorial Library by Mr. N. A. Tucker, Associate Member.

621.795 SURFACE PROCESSES : FINISHING

" Finishing Materials and Methods ", by George A. Soderberg. *Bloomington, Ill., McKnight & McKnight,* 1952. 320 *pages. Illustrated. Diagrams.* $4.00.

The Materials section is devoted to the constituents and manufacture of varnishes; enamels; paints—metallic, luminescent, oil resin emulsions and plastic; stains; removers; coated and polishing abrasives; masking tapes and fire retardants. Illustrations show paint on wood failures with normal and alternatively with aluminium primers.

The methods section deals with brushing, including the manufacture and care of brushes; spraying; tumbling; bleaching; satin and marble finishes; painting of external wood surfaces and metal surfaces including flock application. The operations of taping a wall finished with plasterboard or other wallboard are fully shown. Inlaying silver is an example of several special finishes described. The volume concludes with a chapter on the harmonising of colours and safety measures for personnel and the minimising of fire hazards.

LIBRARY ADDITIONS

621.94 LATHES; SCREW MACHINES

Adam Automatic Cams and Tools Ltd., London. **"Laying out the Cams for 'Tornos' Automatic Lathes."** *London, The Firm.* [n.d.] 86 *pages. Diagrams.*

South Bend Lathe Works, South Bend, Ind. **"How to Cut Screw Threads in the Lathe."** *South Bend, Ind., The Firm.* 1947. 20 *pages. Illustrated. Diagrams.* 10c.

South Bend Lathe Works, South Bend, Ind. **"How to Run a Lathe; Vol. 1, The Care and Operation of a Screw-cutting Lathe."** (50th Ed.) *South Bend, Ind., The Firm.* 1950. 128 *pages. Illustrated. Diagrams.*

South Bend Lathe Works, South Bend, Ind. **"The Installation and Levelling of the Lathe."** *South Bend, Ind., The Firm.* 1947. 20 *pages. Illustrated. Diagrams.*

South Bend Lathe Works, South Bend, Ind. **"Oiling the Lathe: The Importance of Adequate Lubrication."** *South Bend, Ind., The Firm.* 1947. 20 *pages. Illustrated. Diagrams.*

621.95 DRILLING

National Automatic Tool Co., Inc., Richmond, Ind. **"Drills and Drilling Practice."** *Richmond, The Company.* 1945. 54 *pages. Diagrams.* 50c.

624.9 STRUCTURAL ENGINEERING

Institution of Structural Engineers, London. **"Yearbook and List of Members 1952."** *London, John Morris Publicity Ltd. for the Institution.* 1952. 340 *pages.* 5/-

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654 COMMUNICATION SYSTEMS

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Allcutt, E. A. **"Principles of Industrial Management."** *London, Pitman.* 1932. 218 *pages. Illustrated. Charts.*

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669.15 IRON AND STEEL ALLOYS

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669.18 STEEL MANUFACTURE

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669.2 NON-FERROUS METALS

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Gibbs, L. E. **"Cold Working of Brass, with Special Reference to Cartridge (70-30) Brass."** *Cleveland, American Soc. for Metals.* 1946. 104 *pages. Illustrated. Diagrams.* £1 12s. 6d.

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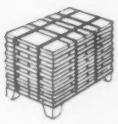

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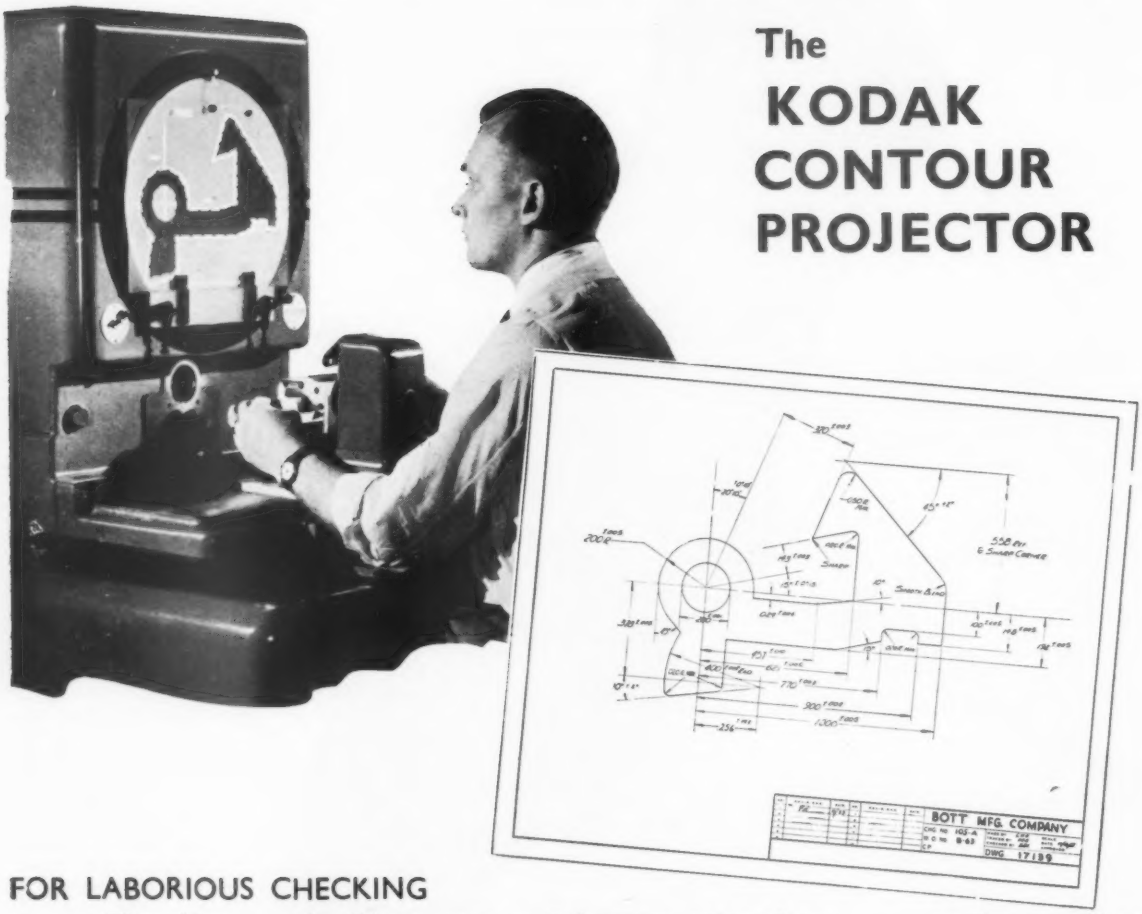

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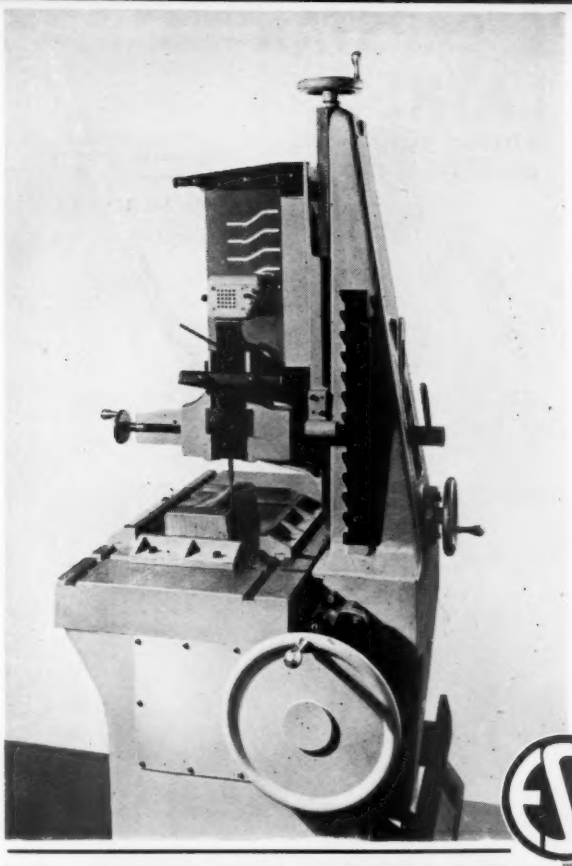

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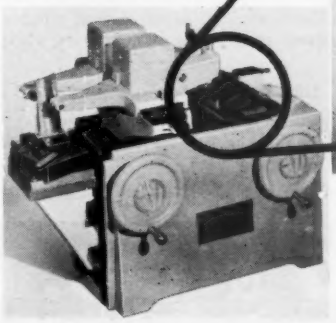

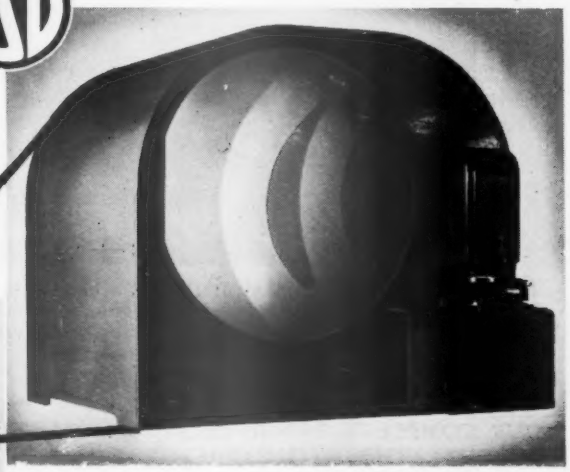

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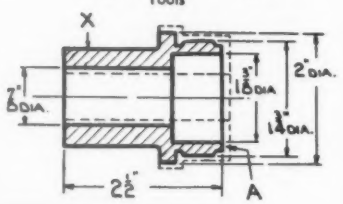

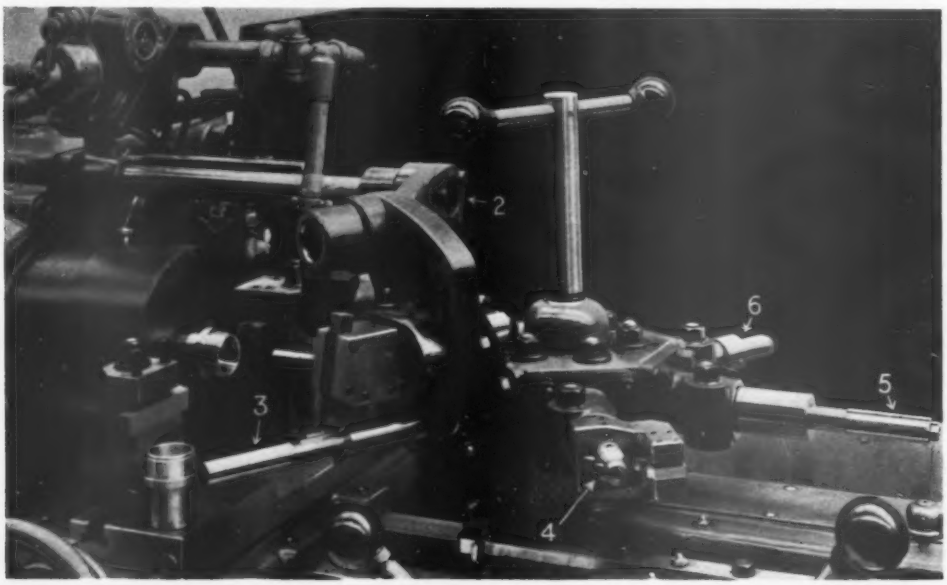

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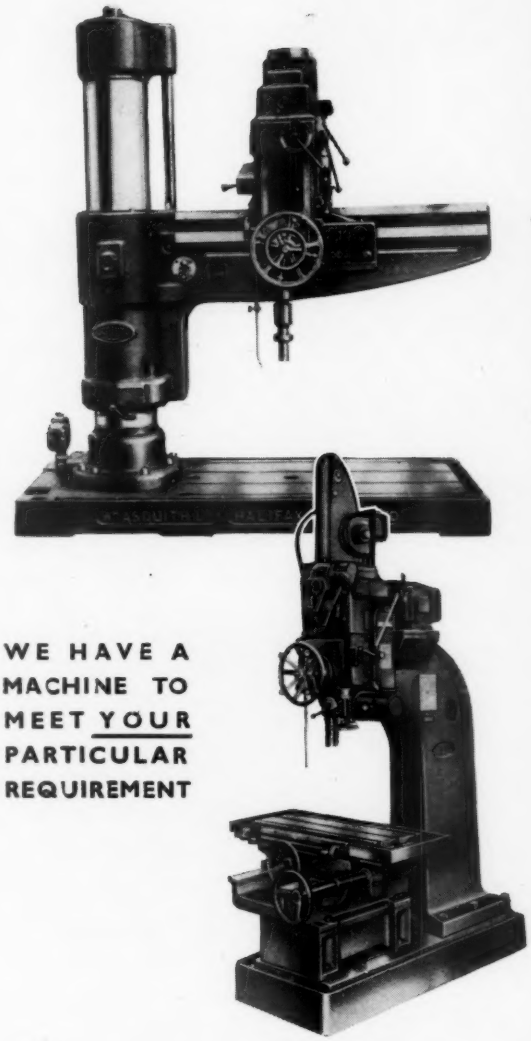

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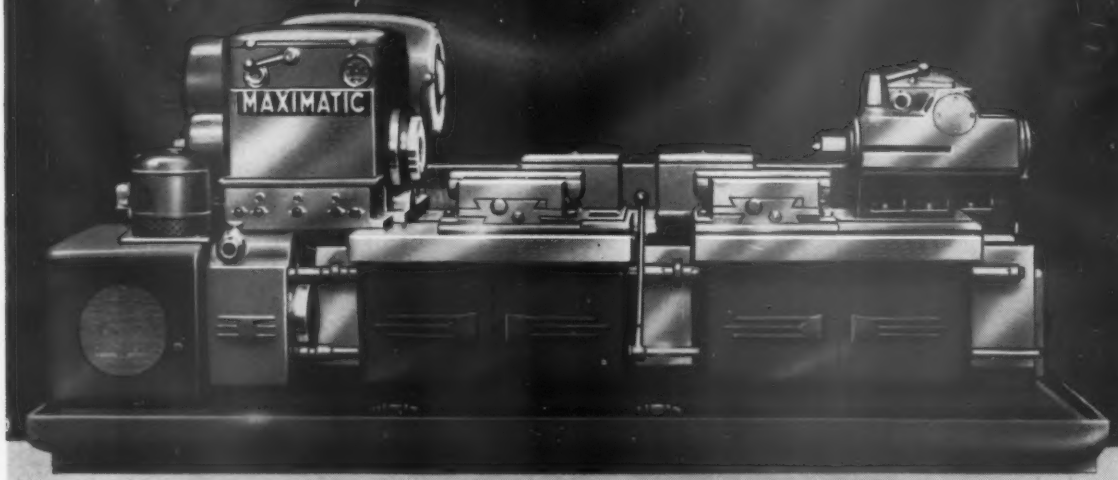

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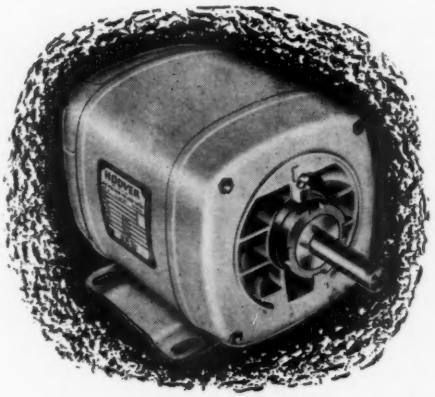

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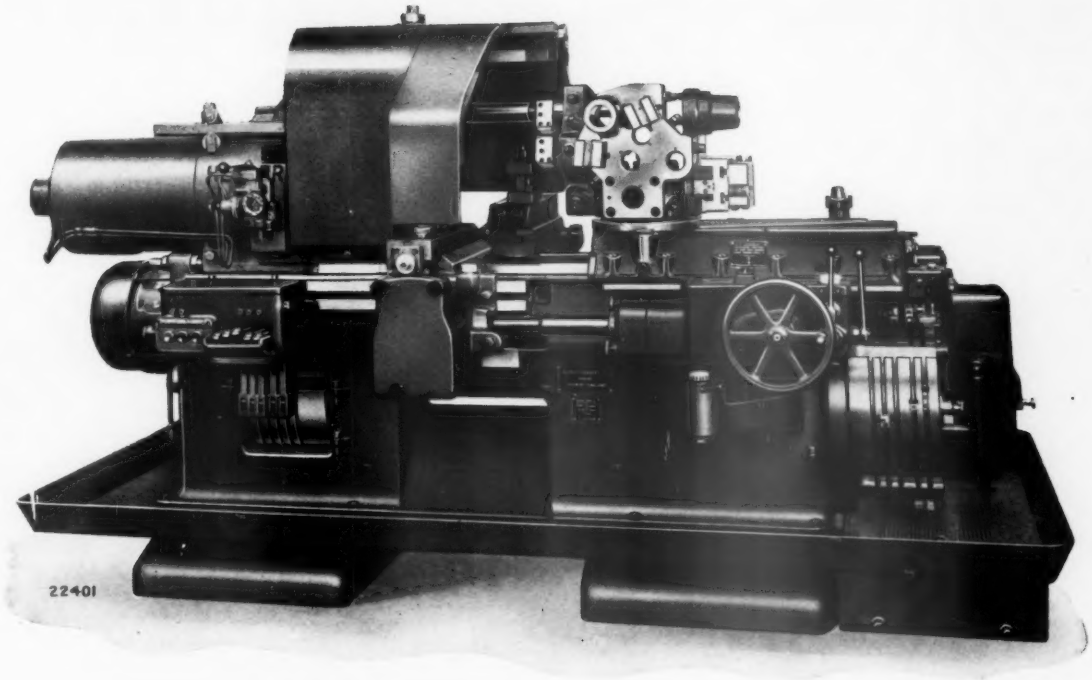

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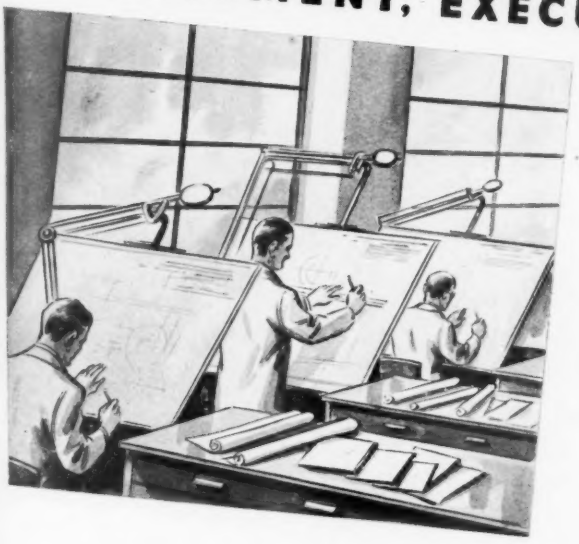

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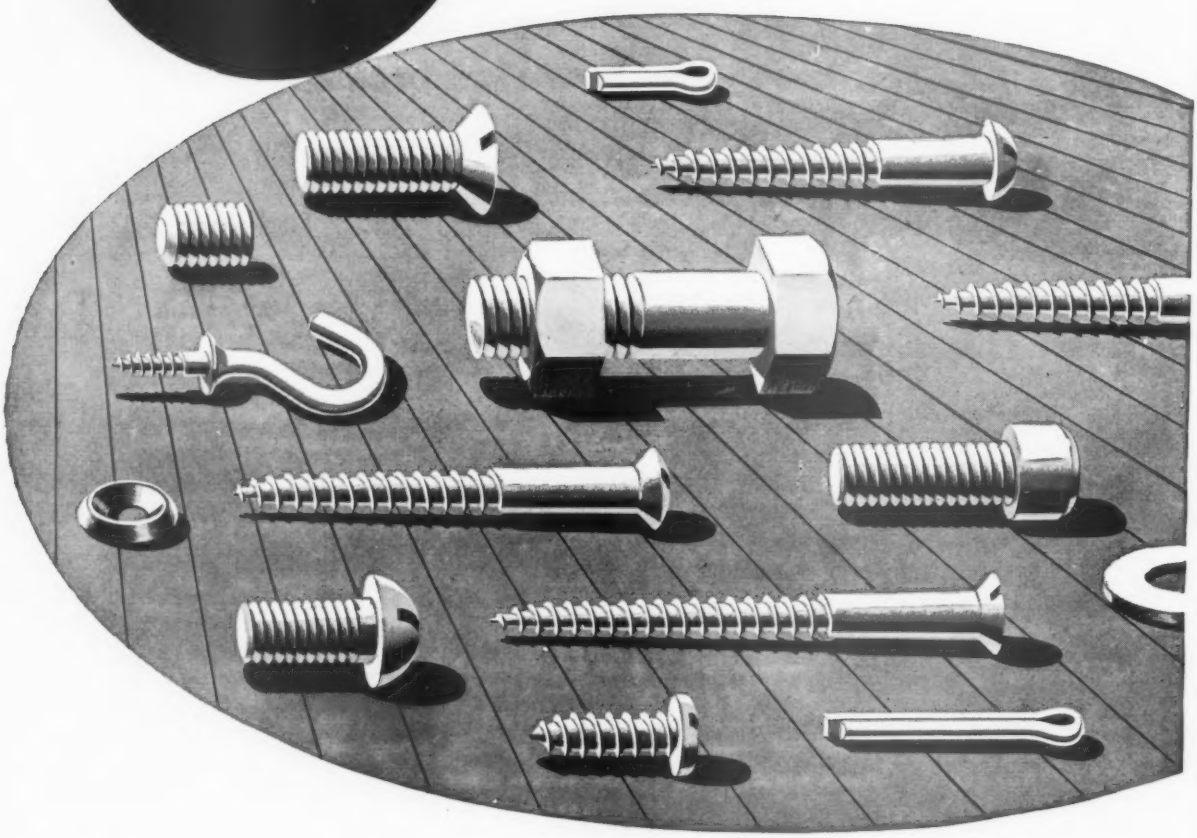

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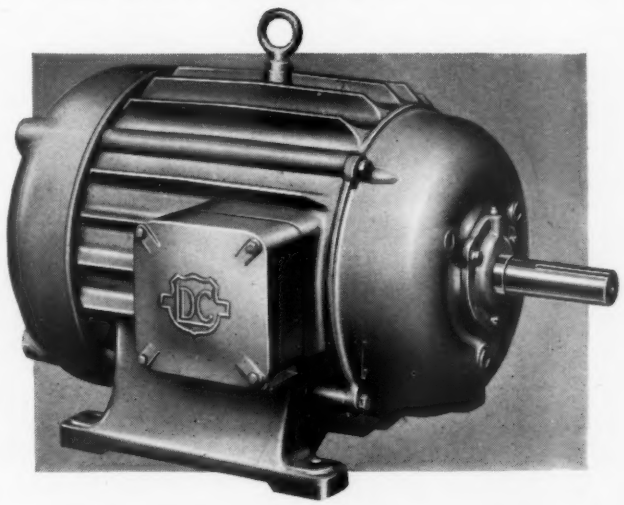

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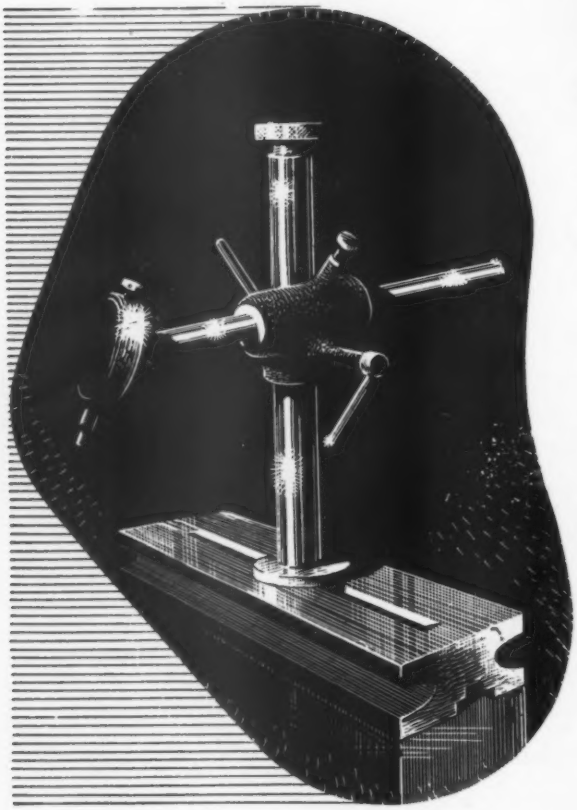

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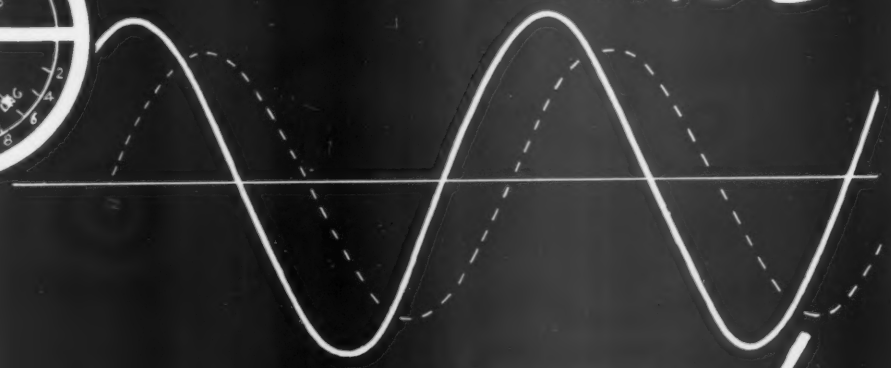

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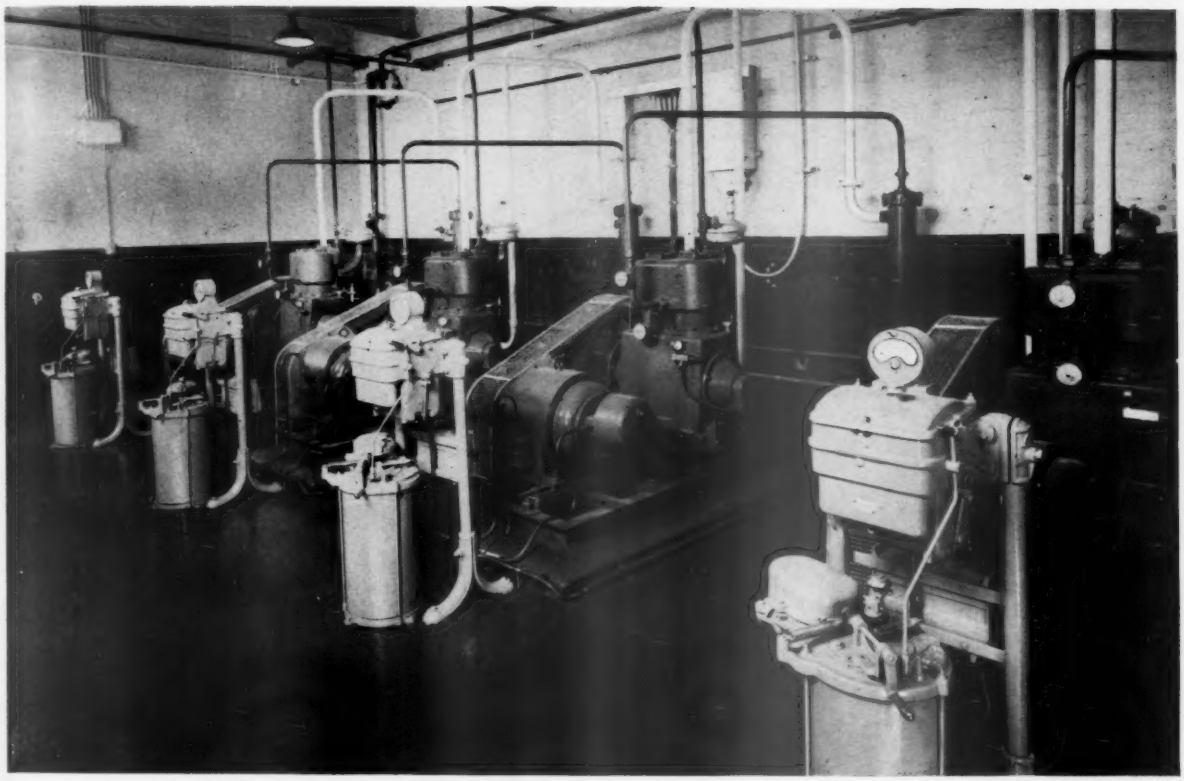

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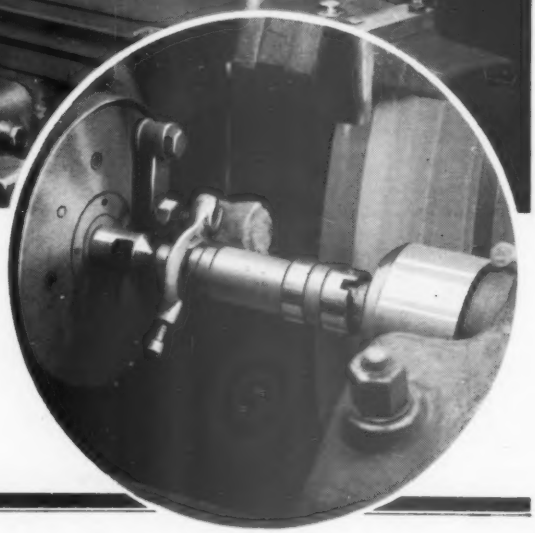

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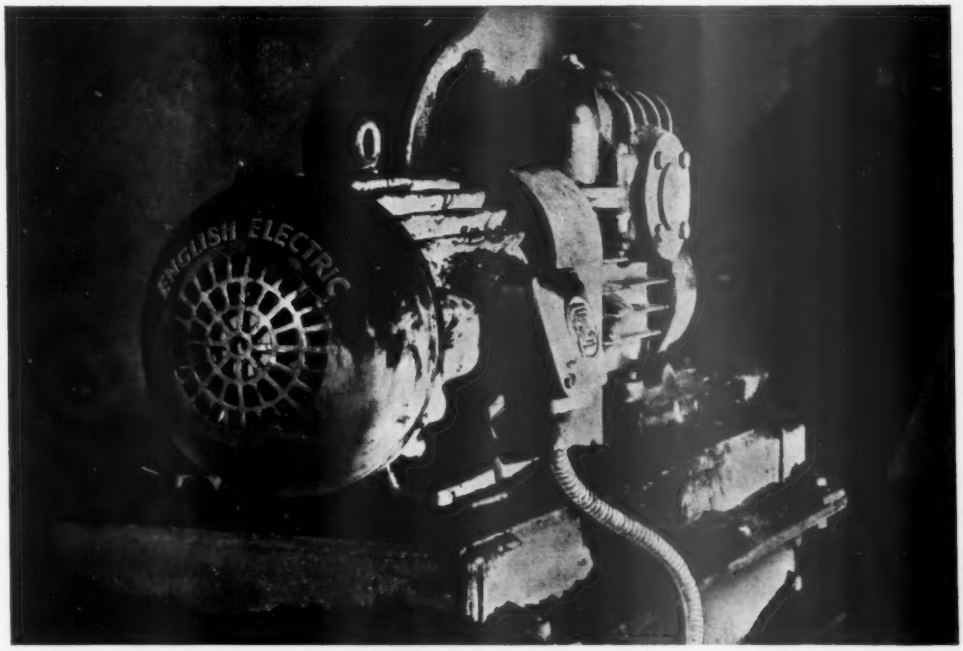

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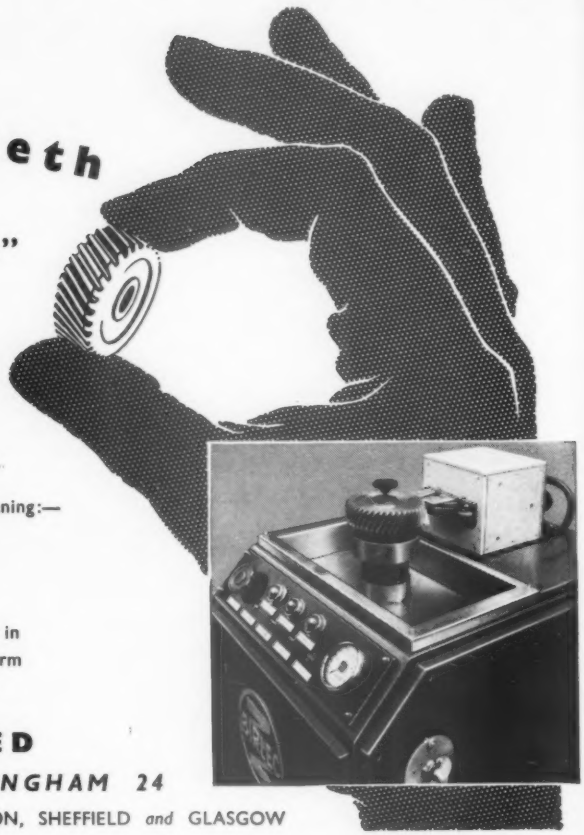

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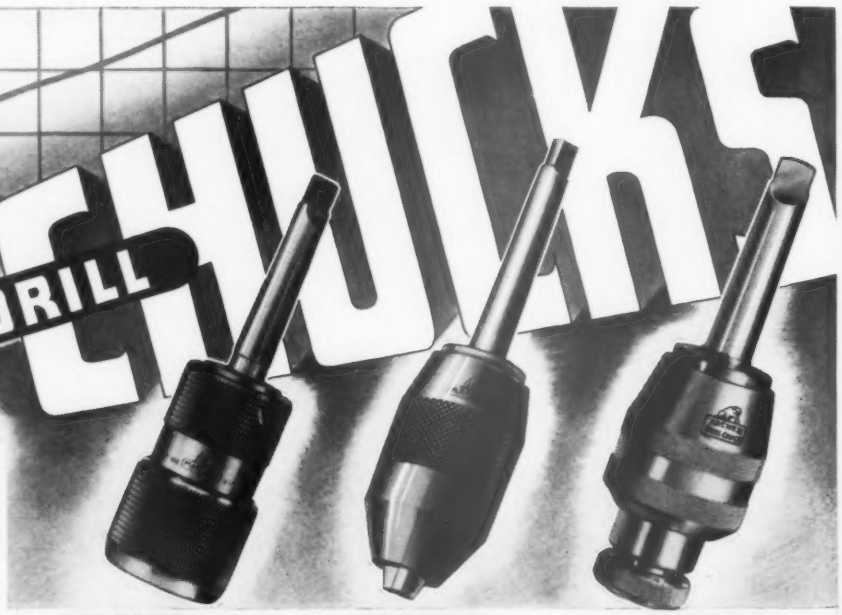

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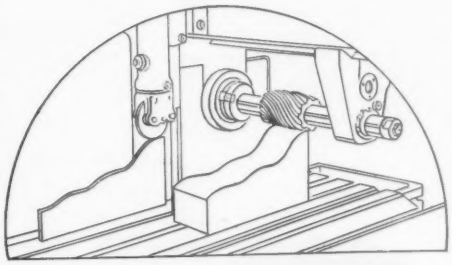

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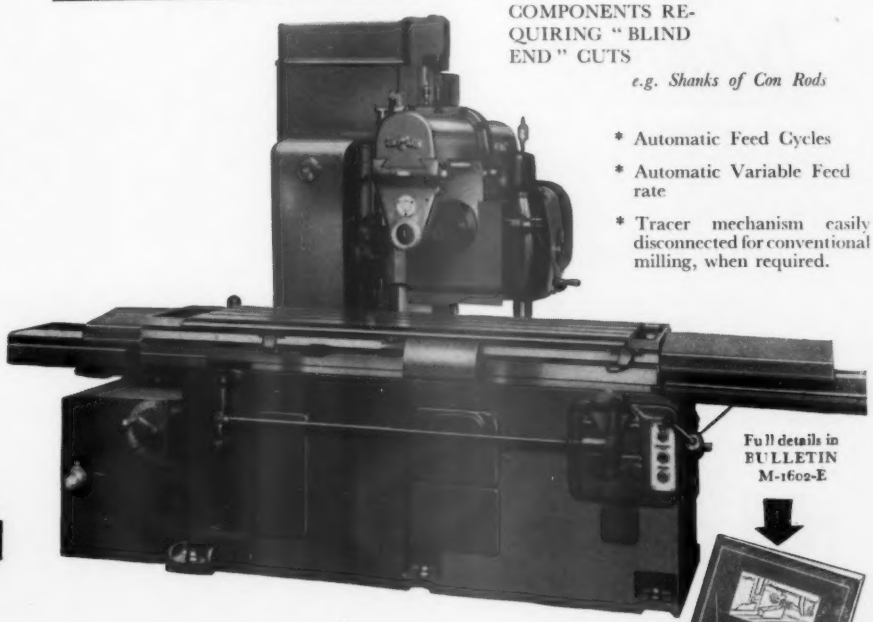

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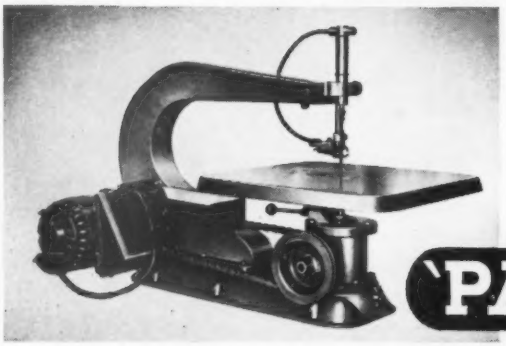

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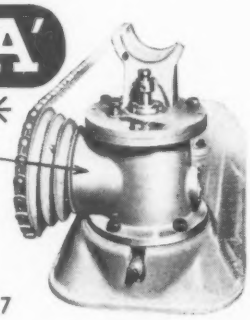

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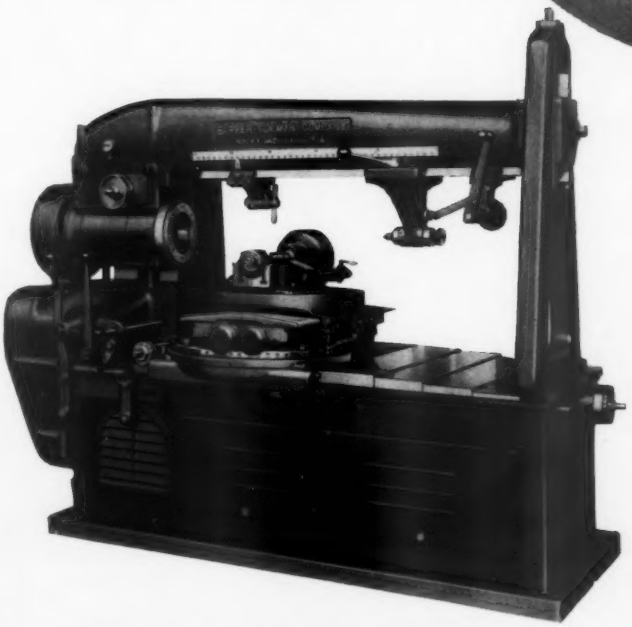

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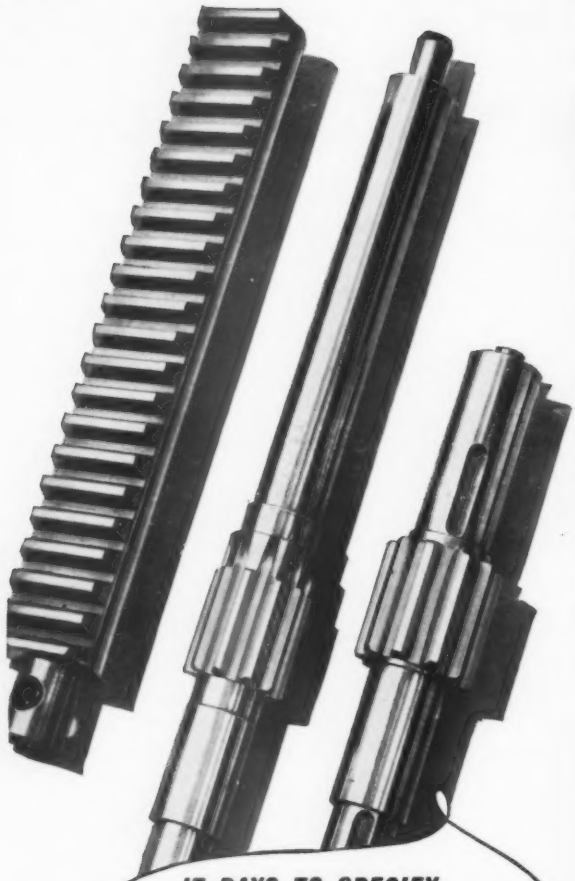

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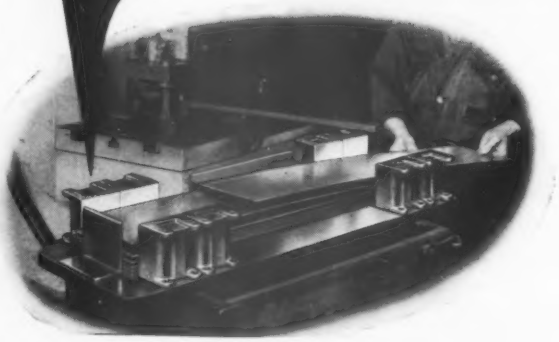

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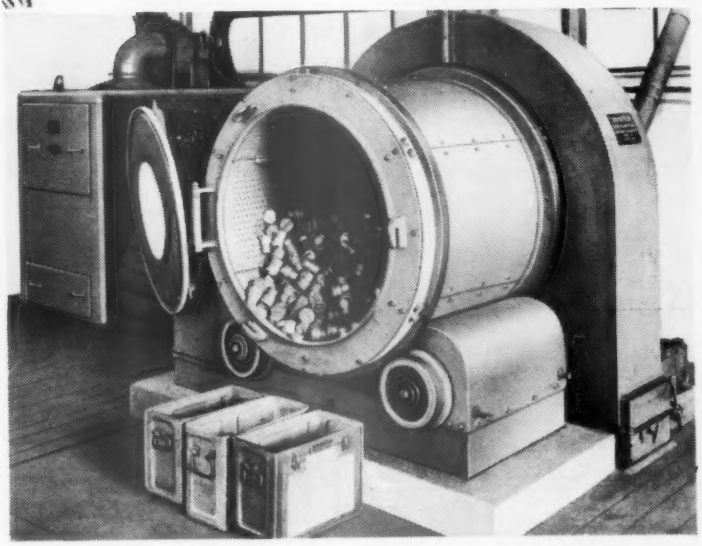

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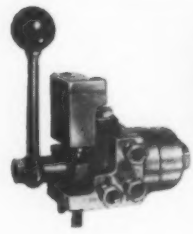

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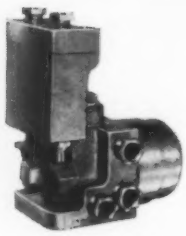

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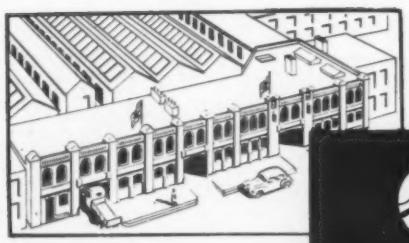

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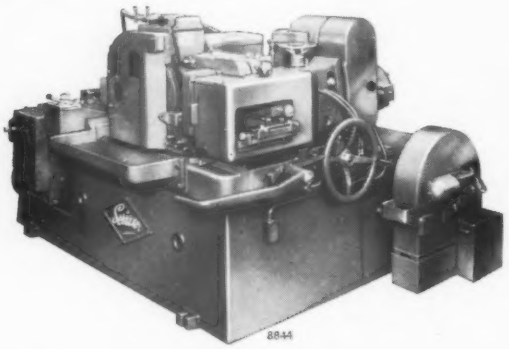

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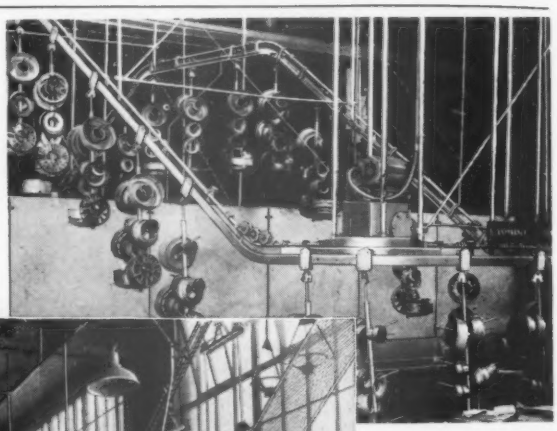

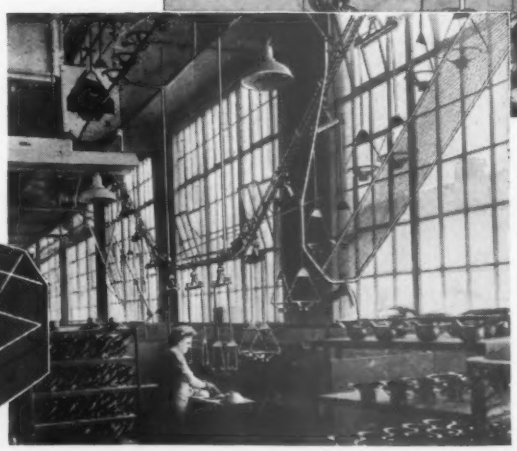

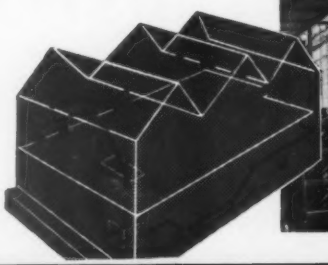

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Left:
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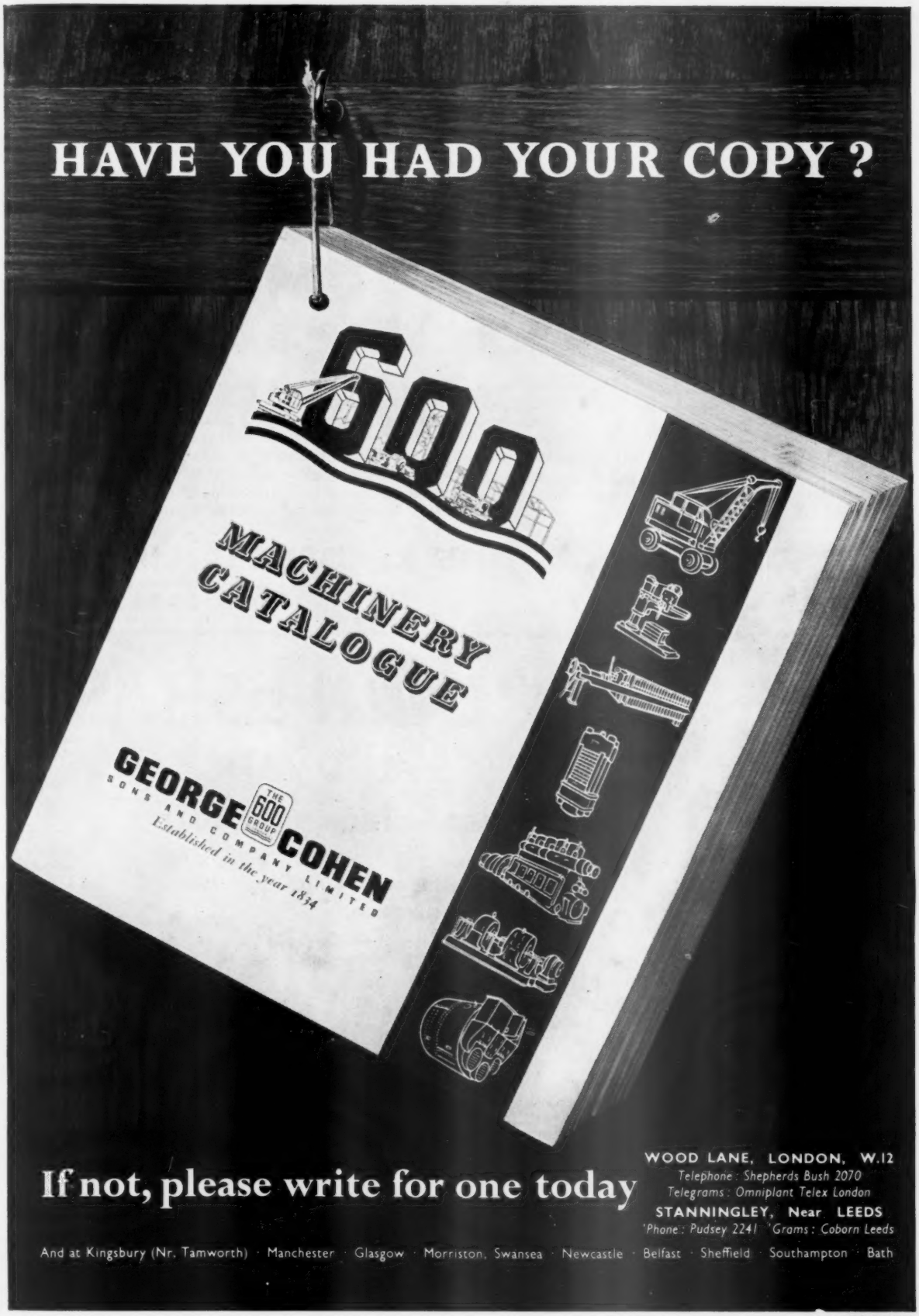
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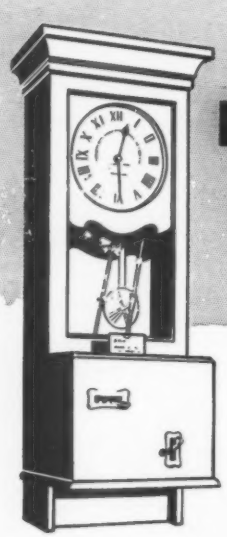

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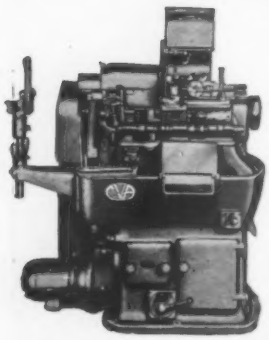

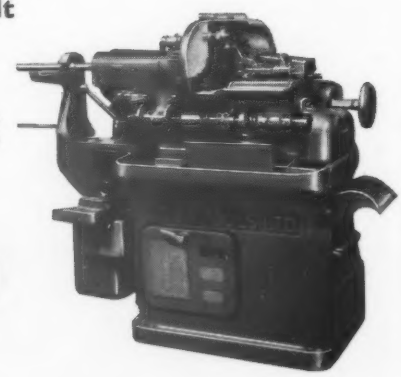

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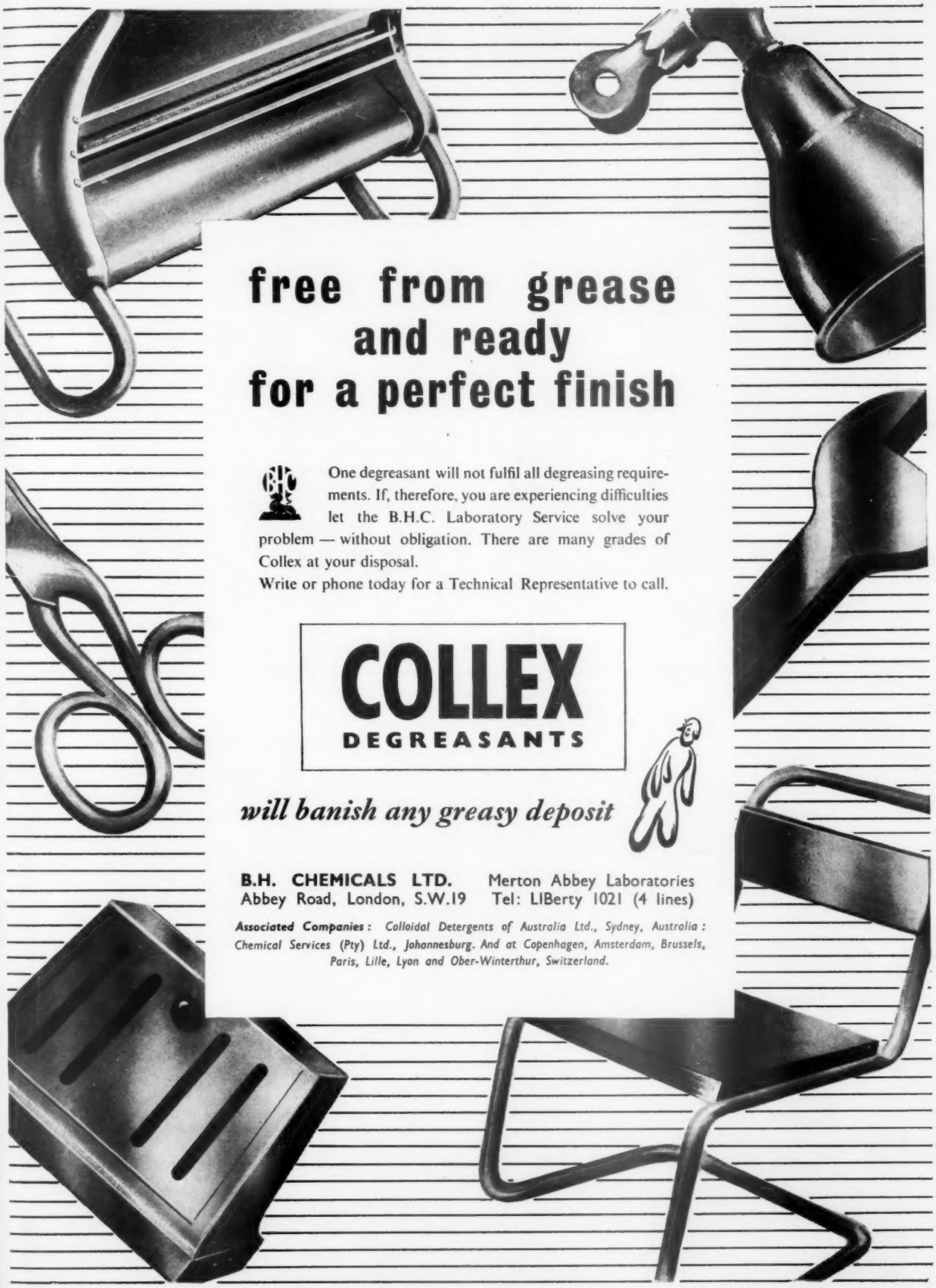
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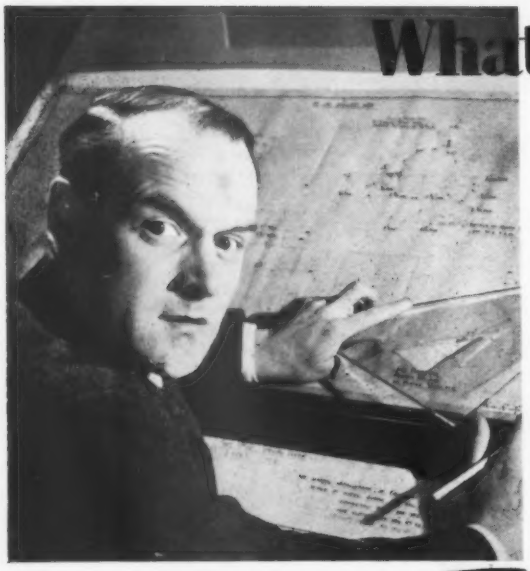

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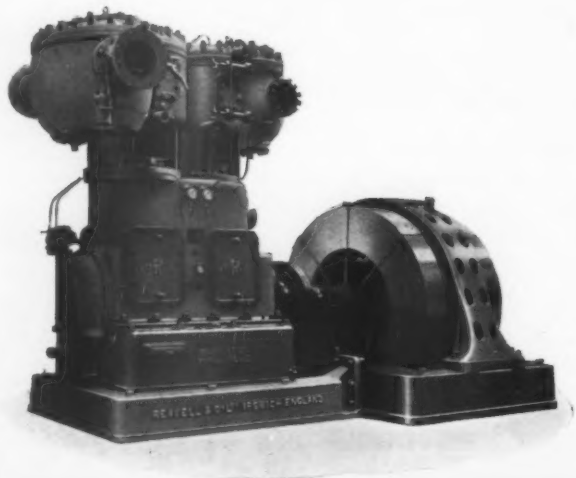

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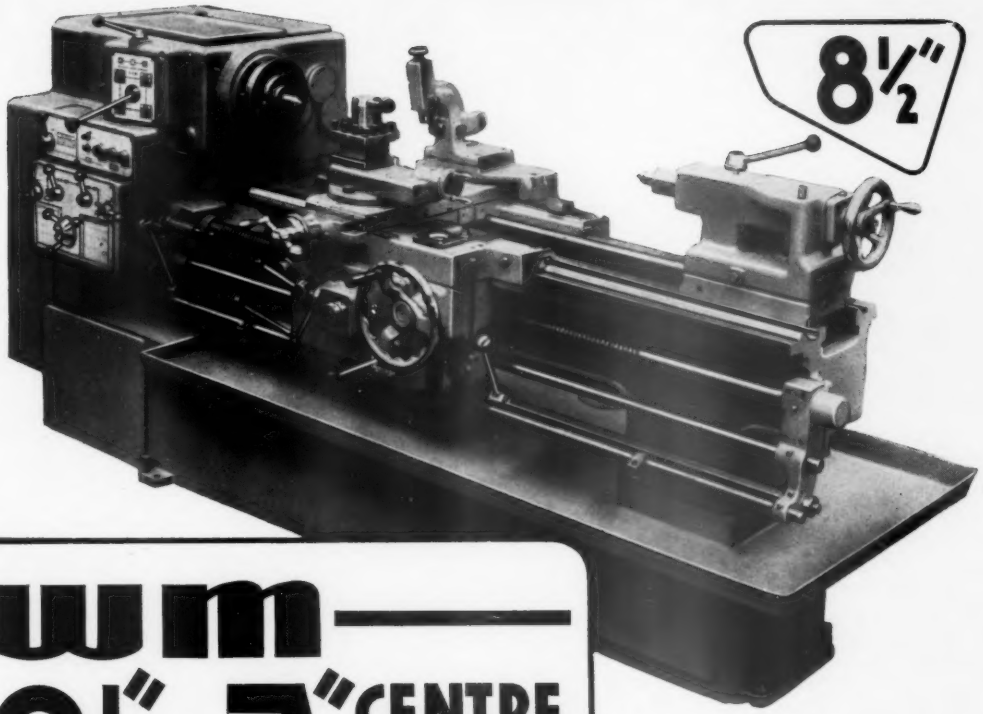

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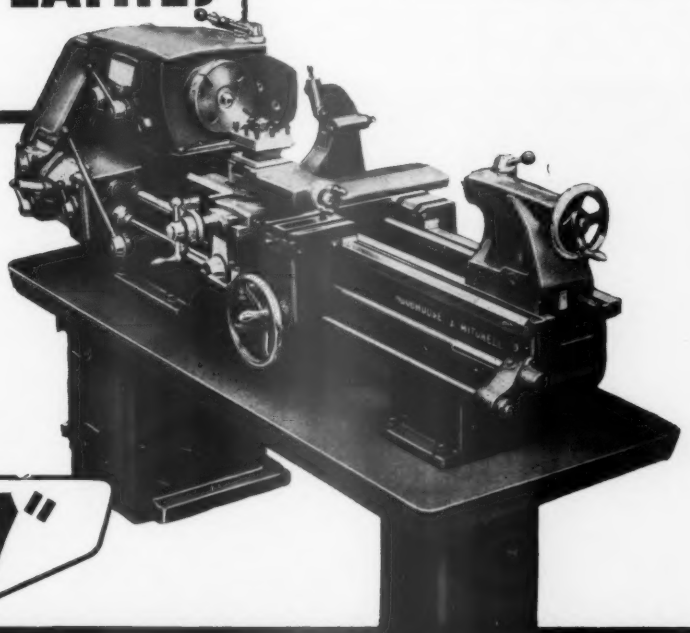

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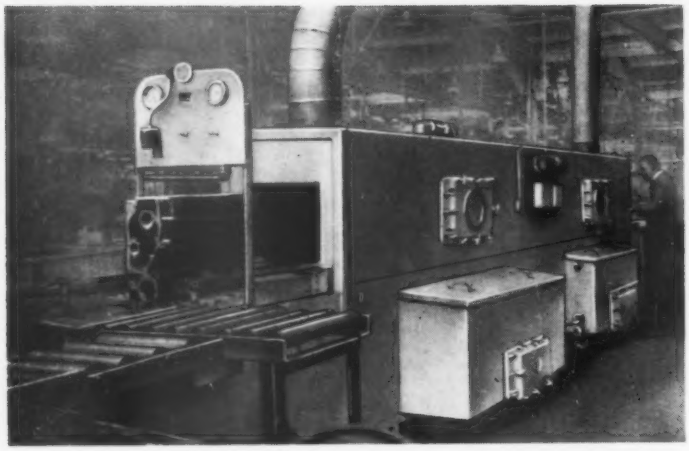

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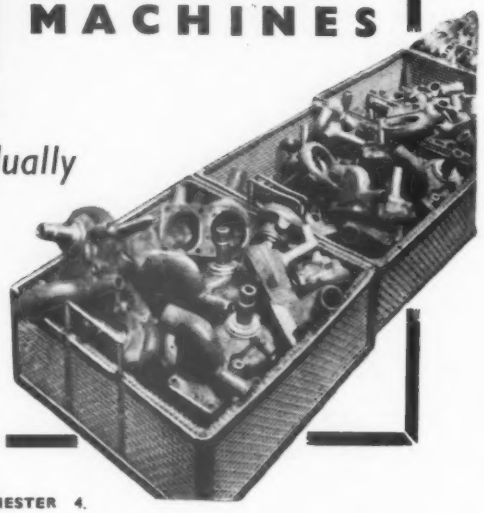

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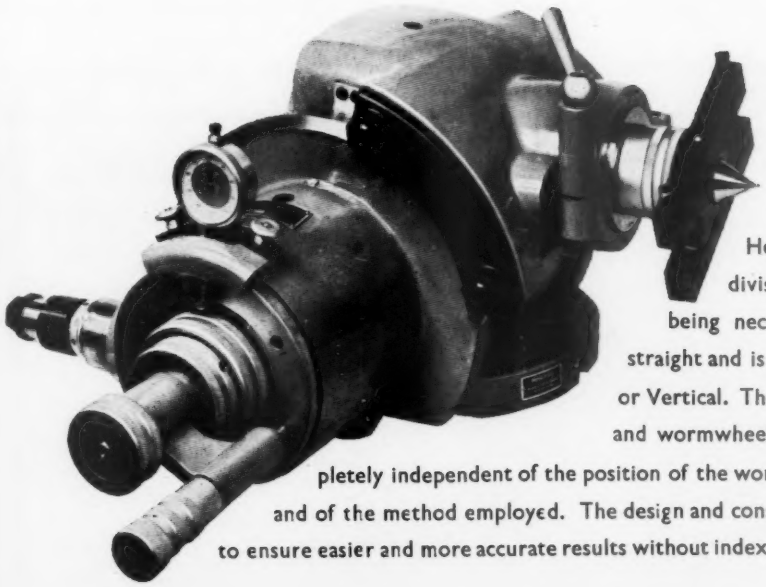

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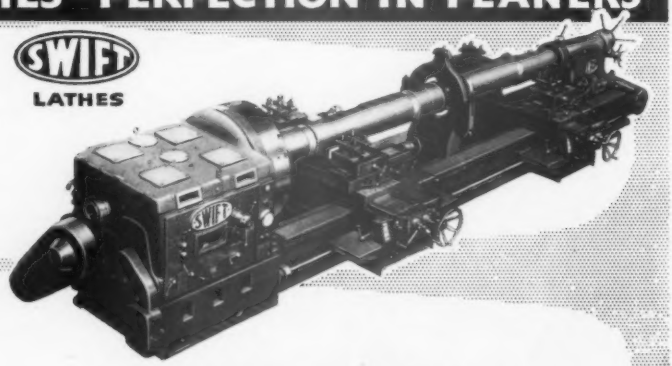

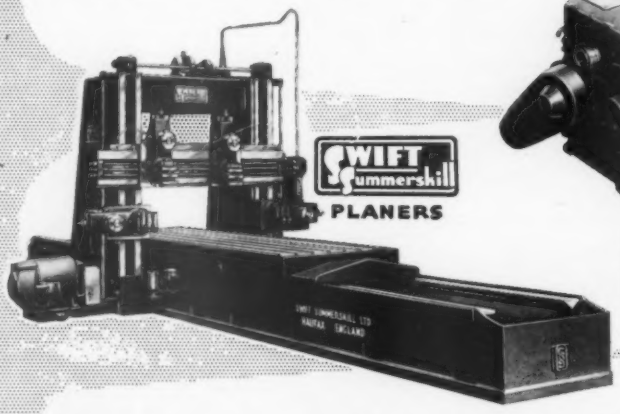

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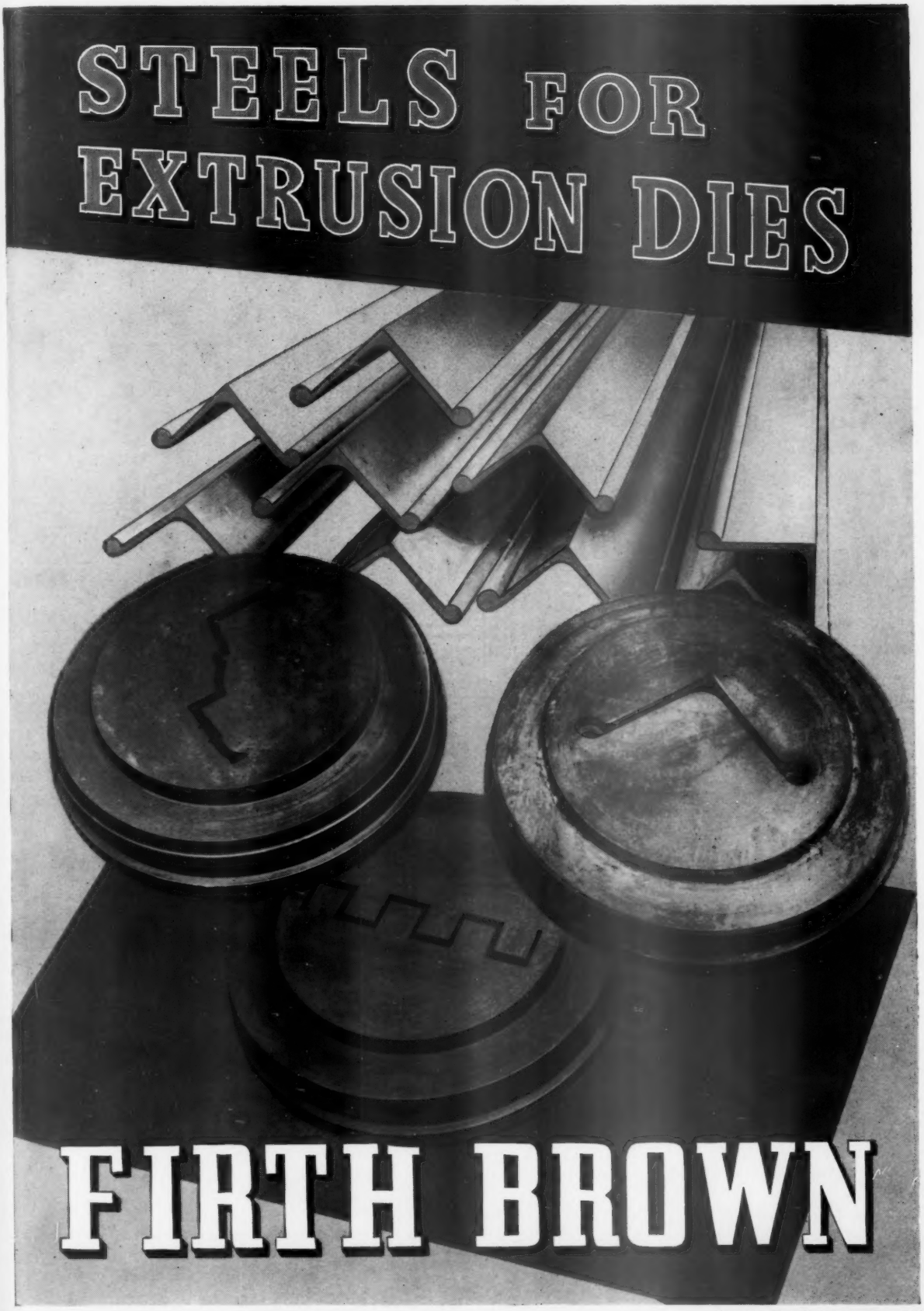

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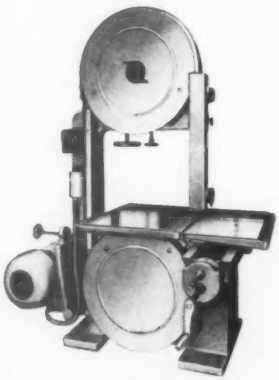

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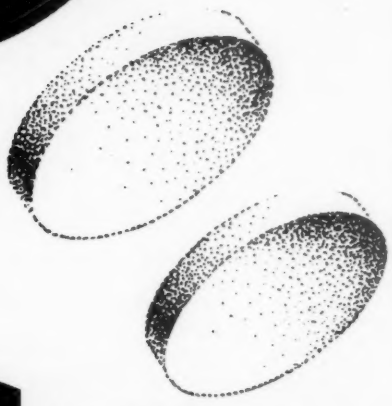

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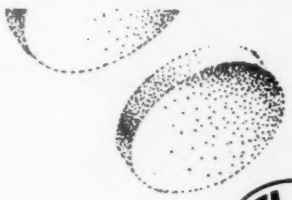

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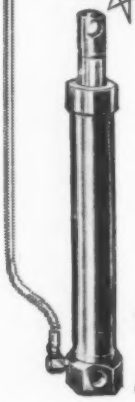

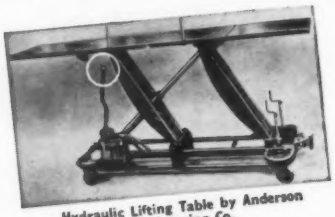

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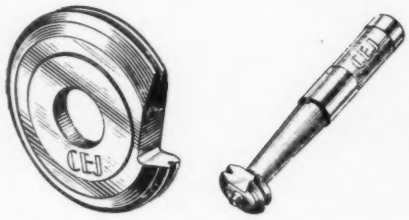

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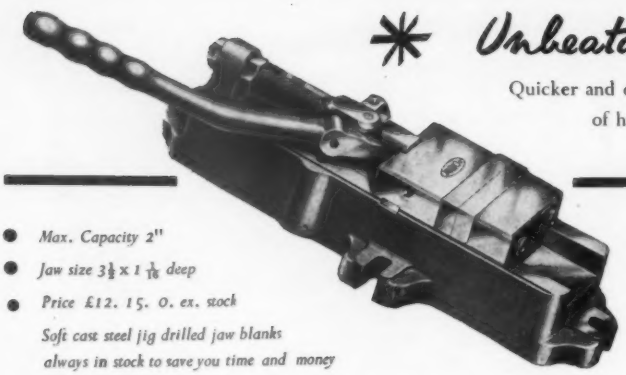

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